Baker (H. B.)

THE ETIOLOGY AND PATHOLOGY OF TYPHOID FEVER.

BY HENRY B. BAKER, M. D., LANSING, MICH.

[Reprinted from the Annual report of the Michigan State Board of Health for the year 1896.]

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ETIOLOGY.

The fact that, by request of a committee, this paper has been prepared to "open a discussion" on the etiology and pathology of typhoid fever, implies that neither of these two branches of the subject is settled. In connection with both branches, there are, however, very many facts which are more or less well established; so it must be one function of this paper to recall to our minds some of these facts, and, if possible, to do this in such order as shall suggest harmonious interpretations of the facts, to aid us in arriving at conclusions concerning the etiology and pathology of this important disease.

1. Filth as a Factor in the Causation of Typhoid Fever.

It seems to me that it is established that typhoid fever is a "filth disease," that is, that what we know as "filth" has had much to do in the causation of typhoid fever.

* A paper read at the meeting of the Michigan State Medical Society, June 4, 1896.

The eminent Sanitarian, Dr. Joseph von Foder, compiled the facts relative to the surroundings of fatal cases of typhoid fever in Buda Pesth, Hungary, during fifteen years—1863–77, with results as follows:—*

Deaths from typhoid fever per hundred houses when the *interior of the dwelling* was:—

1. Very clean	165
2. Clean	177
3. Dirty	182
4. Very dirty	356

There was gradual increase from "very clean" to "dirty," and a very great increase from "dirty" to "very dirty." Compared with the "very clean," there were more than twice the proportion of deaths in the "very dirty" dwellings.

With the yards surrounding the houses, the result was as follows:—

Typhoid fever deaths per one hundred houses when the *yard* was:—

1. Very clean	159
2. Clean	186
3. Dirty	208
4. Very dirty	282

The evidence was conclusive that want of cleanliness outside the dwelling had great influence in the causation of typhoid fever, but not nearly as great as had want of cleanliness inside the dwelling.

Other evidence that filth is a factor in the causation of typhoid fever, is the experience in Munich before and since the filth of the city has been promptly carried out of the city by means of sewerage: Thus, in 1852–9 when the drinking water was from wells, and the human excreta was stored in overlying vaults, the mortality from typhoid fever was 24.2 per 10,000 inhabitants. In 1860 the vaults were required to be cemented; in 1860–7 the typhoid mortality was reduced to 16.6 per 10,000. In 1866–73 a system of sewers was commenced, involving the commencement of the use of a general water-supply; in 1868–75 the typhoid mortality fell to 12.7. The sewers were continued in 1874–80, in 1877–79 the typhoid mortality was reduced to 7.8. In 1881–4 the sewers were further continued, and a good spring water was added to the general water-supply; the typhoid mortality decreased, until in 1884 it was only 1.4 per 10,000 inhabitants.† The death rate from typhoid was then only about one-seventeenth what it had been when Munich drank water into which human filth percolated.

This indicates the *nature of the filth* which seems to have causal relation to typhoid fever,—the excretions of human bodies. This evidence of the etiology is in harmony with some of the evidence of the pathology of the disease,—one approved name of the disease is "enteric fever"; an important effect of the disease is in the intestine; it is reasonable to suppose that the cause of the disease may be given off from that part of the body in which the pathological change occurs. Apparently this is true; the disease appears to be spread by a cause which goes from the intestine,‡ and is capable of producing the disease when it reaches the intestine of another person.

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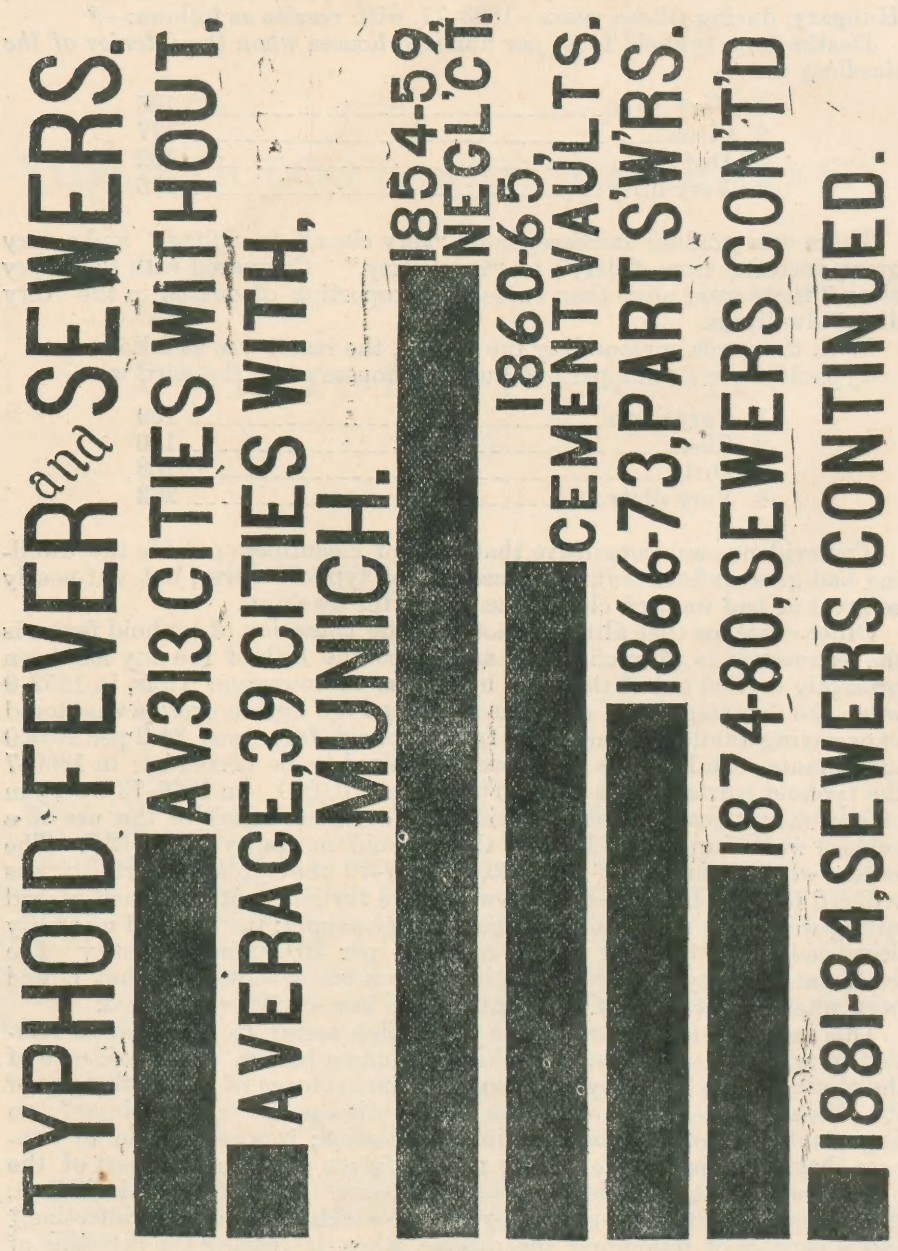
*Archiv für Hygiene Zweiter Band, 1884, Zeite 269, 272.

†This is graphically exhibited in the diagram, p. cxliv.

‡ Recent investigations make it probable that the urinary excreta also convey the germs of typhoid fever. Experiments by Wright and Semple, London Lancet July 27, 1895, page 196.


TYPHOID FEVER and SEWERS.
AV. 313 CITIES WITHOUT.
AVERAGE, 39 CITIES WITH,
MUNICH.
1854-59, NEGL'CT.
1860-65, CEMENT VAULTS.
1866-73, PART S'W'RS.
1874-80, SEWERS CON'T'D
1881-84, SEWERS CONTINUED.

[PLATE NO. 651.]

Typhoid Fever Among Plumbers.

In a report of the Board of Health of Montclair, New Jersey, mention was made of a plumber being attacked by typhoid fever in consequence of having made repairs in one or more of the houses in which the fever had occurred.* A similar case occurred under my observation in Lansing, Michigan, a few years ago.

Is the Cause a Chemical Poison, or is it Specific.

Many classes of facts seem to demonstrate that the cause of typhoid fever cannot be simply a non-living chemical poison not capable of reproduction, and that it must be an organized body capable of reproduction and continuous multiplication. For instance, as an illustration, from a house in Philadelphia in which there was typhoid fever, a man went to Plymouth, Pa., was taken sick with typhoid fever, his discharges were thrown out on the snow which melted and was washed into a small mountain stream which served as the source of a public water-supply. In a short time about a thousand persons who drank that water contracted typhoid fever, while many other persons in the same village who drank water from wells, the water from which when analyzed at the laboratory of the Michigan State Agricultural College was found to be very much more badly contaminated with leachings from human excreta, did not then contract typhoid fever; although, afterwards, when there had been opportunity for the privies to have been "infected" with typhoid discharges, the disease appeared, in some instances, to have been contracted from water in the underlying wells. In the mountain stream the dilution was such as to make it impossible that so many cases of fever could have been caused by any chemical poison; there must have been reproduction of the "infection" in the intestines of the patients. And the contaminated well water did not cause typhoid fever until after it became infected.

At Cumberland, Md., in 1889–90, the evidence is that typhoid fever was not present until the discharges from a *typhoid patient* living on one of the little streams which empties into the Potomac about 200 feet above the pumping station, found their way into the city water supply.† Dr. Kober, who has made a special study of the subject, says: "Such instances can be recited by the hundreds."† I am myself familiar with many such instances.

In a great many instances, notably the outbreak at Plymouth, Pa., the tendency of such evidence is to prove that typhoid fever is not caused by non-infected human excreta; but by excreta of typhoid fever patients.

This is equivalent to saying that typhoid fever is caused by a specific organism, or organisms.

The Practical Restriction of Typhoid Fever Proves its Communicability.

The lessening of typhoid fever by sewerage and improved water-supplies, shown in diagrams and charts I and II, submitted herewith,‡ is evidence that typhoid fever is communicable, and that it may be restricted by the measures mentioned.

* Jour. Am. Med. Assoc., Vol. 23, page 691.
† Report of Dr. George M. Kober, in Annual Report Comm. Dist. of Columbia, 1895, page 259. Pages cxlvi-cxlvii.

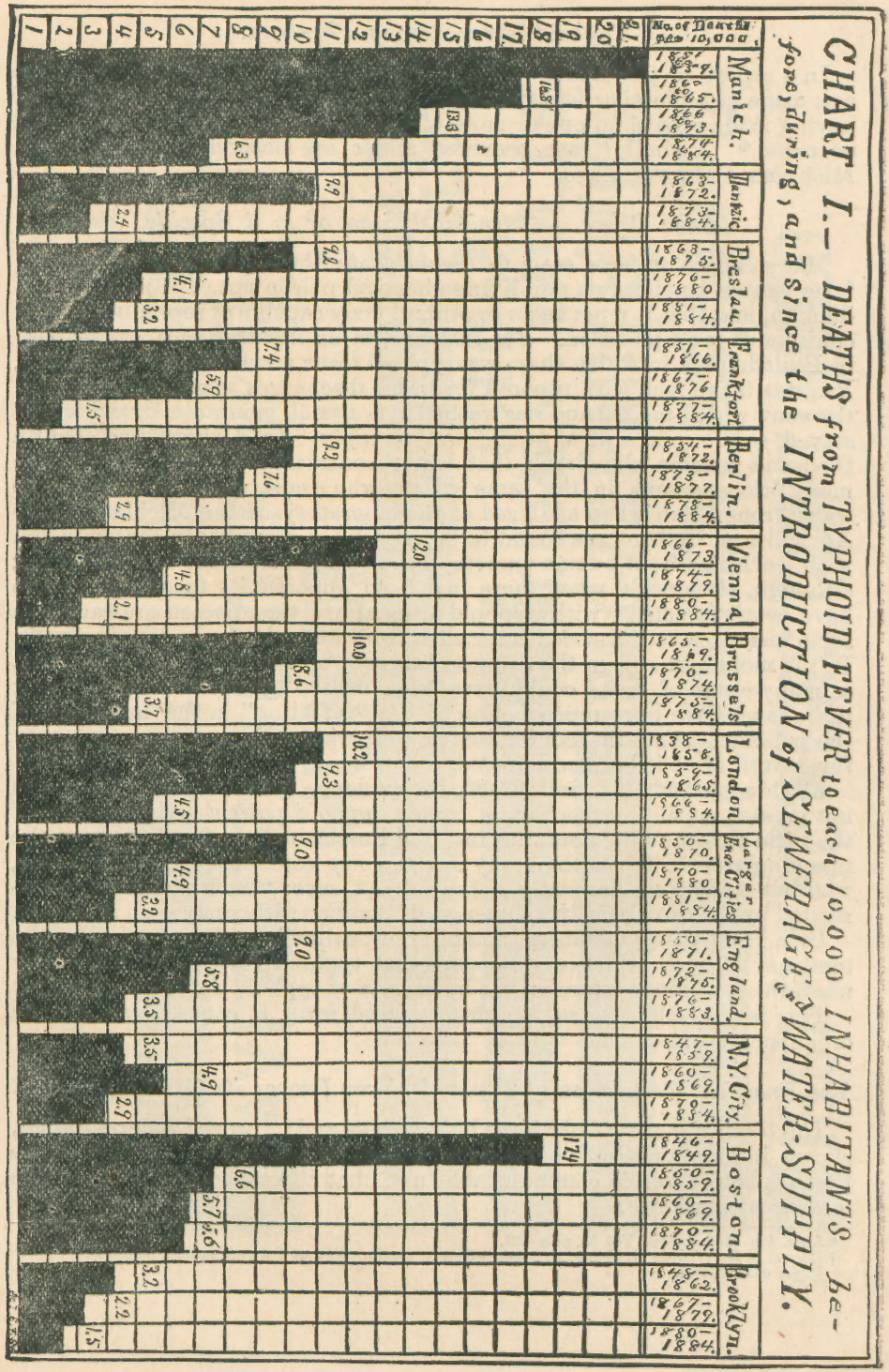


CHART I.— DEATHS from TYPHOID FEVER to each 10,000 INHABITANTS before, during, and since the INTRODUCTION of SEWERAGE and WATER-SUPPLY.
No. of Deaths Pr. 10,000.
Munich.
Manchester.
Breslau.
Frankfort
Berlin.
Vienna.
Brussels
London
Large Eng. Cities
England
N.Y. City.
Boston.
Brooklyn.
1857-1863.
1863-1872.
1873-1884.
1876-1884.
1863-1872.
1873-1884.
1851-1860.
1861-1870.
1871-1880.
1881-1884.
1851-1866.
1867-1876.
1877-1884.
1834-1872.
1873-1877.
1878-1884.
1866-1873.
1874-1879.
1880-1884.
1865-1869.
1870-1874.
1875-1884.
1838-1853.
1854-1863.
1864-1884.
1850-1870.
1870-1880.
1881-1884.
1850-1871.
1872-1875.
1876-1883.
1847-1859.
1860-1869.
1870-1884.
1846-1849.
1850-1859.
1860-1869.
1870-1884.
1848-1862.
1867-1879.
1880-1884.
No. of Deaths Pr. 10,000.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
13.3
12.8
6.3
2.9
2.4
4.2
4.1
3.2
7.4
5.9
1.5
9.2
7.4
2.9
12.0
4.6
2.1
10.0
8.6
3.7
10.2
4.3
4.5
9.0
4.9
3.2
20
3.8
3.5
3.5
4.9
2.9
17.4
6.6
5.7
5.6
3.2
2.2
1.5

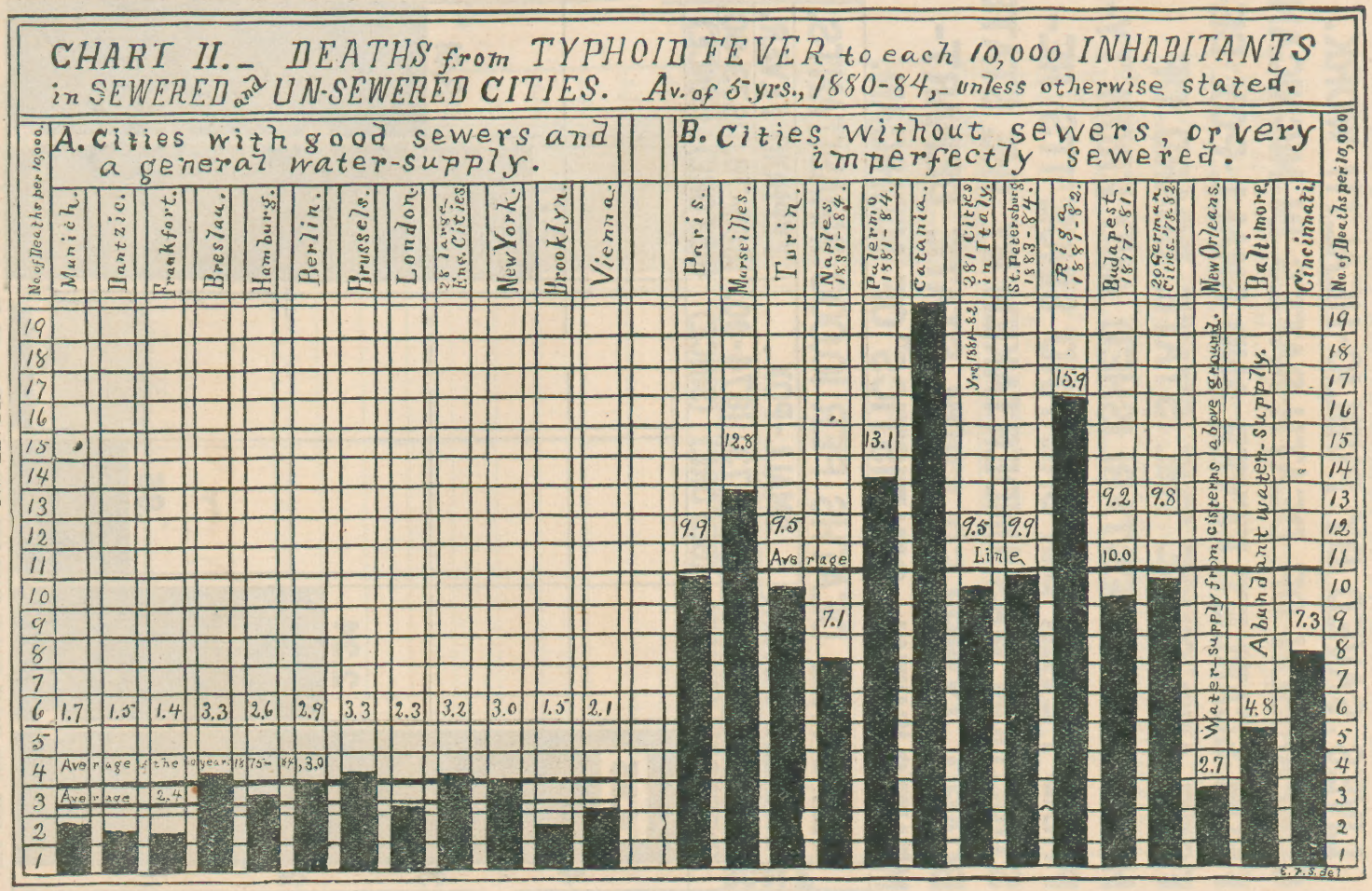


CHART II.— DEATHS from TYPHOID FEVER to each 10,000 INHABITANTS in SEWERED and UN-SEWERED CITIES. Av. of 5 yrs., 1880-84,— unless otherwise stated.
A. Cities with good sewers and a general water-supply.
B. Cities without sewers, or very imperfectly sewered.
No. of Deaths per 10,000.
Munich
Dantzic
Frankfort
Breslau
Hamburg
Berlin
Brussels
London
28 large Eng. Cities
New York
Brooklyn
Vienna
Paris
Marseilles
Turin
Naples 1881-84
Palermo 1881-84
Catania
281 Cities in Italy
St. Petersburg 1883-84
Riga 1881-82
Budapest 1877-81
29 German Cities 1882
New Orleans
Baltimore
Cincinnati
1.7
1.5
1.4
3.3
2.6
2.9
3.3
2.3
3.2
3.0
1.5
2.1
Average of the 10 years 1875-84, 3.0
Average 2.4
9.9
12.8
9.5
7.1
13.1
9.5
9.9
15.9
9.2
9.8
10.0
2.7
4.8
7.3
Average Line
Water-supply from cisterns above ground.
Abundant water-supply.
E. T. S. del.

LIVES SAVED BY PUBLIC-HEALTH WORK. COMPARISON OF DEATH-RATES IN MICHIGAN FROM SCARLET FEVER AND SMALL-POX BEFORE AND SINCE THE STATE BOARD OF HEALTH WAS ESTABLISHED AND FROM TYPHOID FEVER BEFORE AND SINCE ITS RESTRICTION WAS UNDERTAKEN BY THE STATE BOARD. COMPILED FROM STATE DEPARTMENT'S "VITAL STATISTICS" OF MICHIGAN.

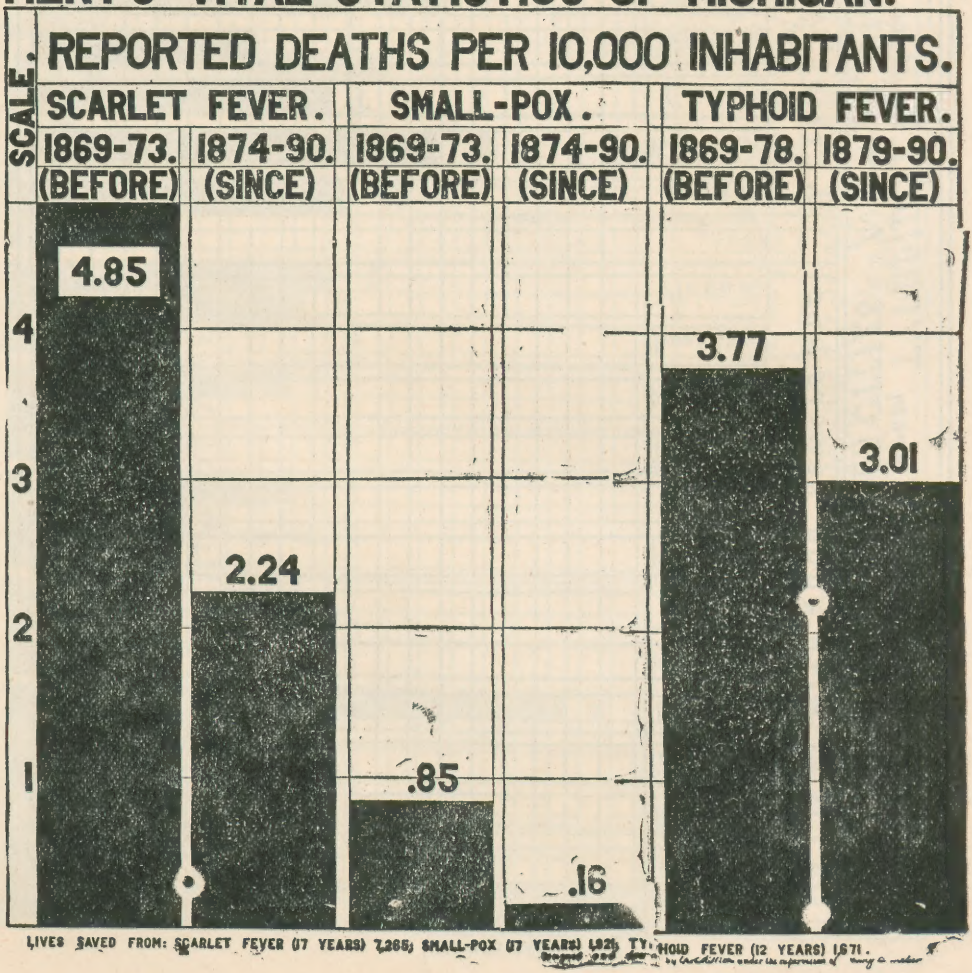
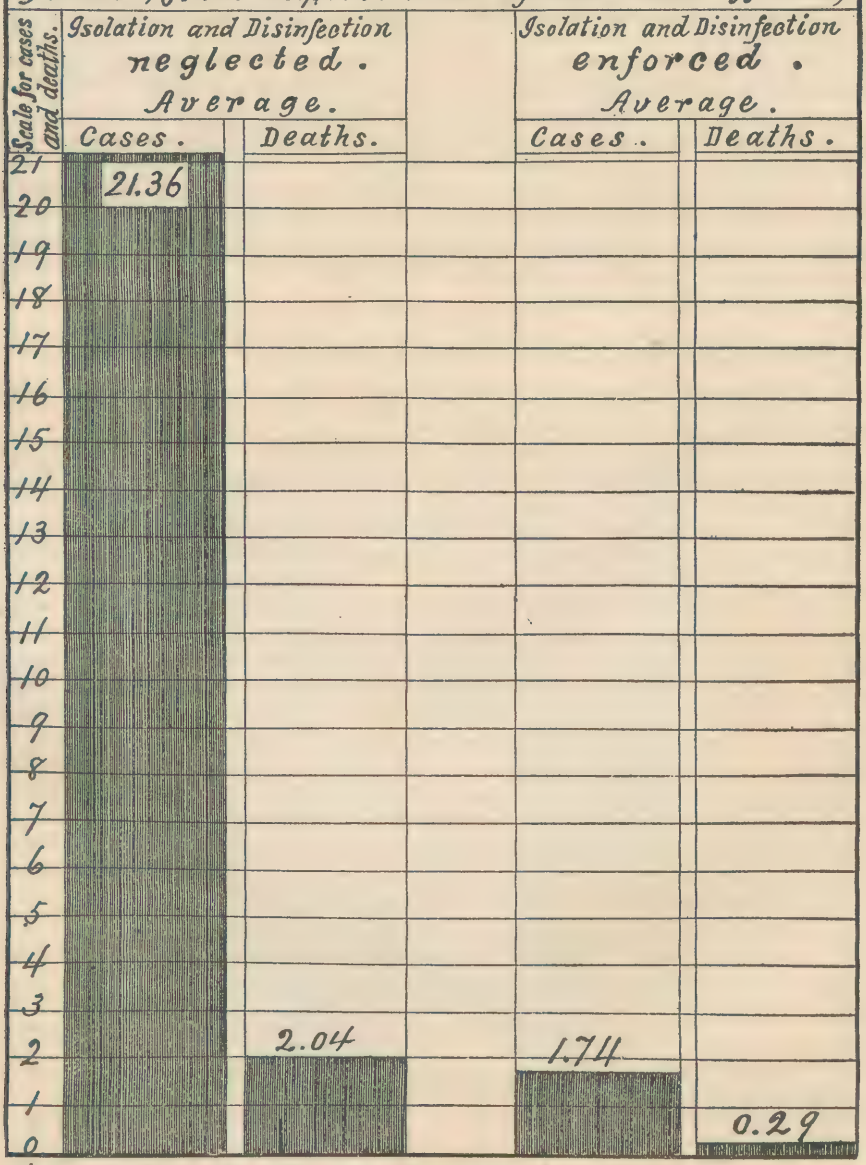


PLATE NO. 517.

Isolation and Disinfection Restrict Typhoid Fever.

Typhoid Fever in Michigan in 1891:- Exhibiting the Average numbers of cases and deaths per outbreak:- in all outbreaks in which Isolation and Disinfection were both neglected; and in all outbreaks in which both were enforced.* (Compiled in the office of the Secretary of the State Board of Health, from reports made by local health officers.)



*Including the disinfection of the bowel discharges of the patients.

A similar line of evidence is that in the diagram, entitled "Lives Saved by Public-Health Work,"* wherein it is shown that during those years in which the State Board of Health has been laboring for the restriction of typhoid fever the mortality has been less than it was before. That diagram relates to the entire State; if we confine the inquiry to local outbreaks, and separate them into two classes, as is done in the construction of the diagrams "Isolation and Disinfection Restrict Typhoid Fever,"† it is plain that isolation and disinfection restrict typhoid fever, which implies that it is a communicable disease. The disinfection includes that of the bowel discharges from the patient; and it should, by all means, have included that of everything in any way soiled by their urine which, in some instances, has been found to be almost a pure culture of the typhoid bacillus.‡

In the outbreaks studied, probably the urine, dried on linen, has been entirely overlooked as a cause of typhoid fever. But the evidence seems to be conclusive that in townships, villages, and small cities typhoid fever may be restricted so that only about two cases, and an average of one-fourth of one death shall occur to each outbreak. In the year 1891 a few epidemics greatly increased the average in localities where isolation and disinfection were neglected, but the results of isolation and disinfection were about the same as in the other years.

Typhoid Fever is a Communicable Disease Sometimes Waterborne.

It seems to me to be established that typhoid fever is a specific communicable disease. How is it communicated?

The facts relative to the lessening of typhoid fever in Munich, and facts of similar import in cities throughout the world, seem to demonstrate that the prompt removal of excreta by sewers, associated as that usually is with an uncontaminated water supply, decreases the *spread of typhoid fever.*

"The example of Dantzig, however, shows that an *abundant* water-supply alone does not diminish the death-rate. This city was supplied with water in 1869, and sewered in 1872. No marked diminution in the death-rate of typhoid fever occurred until after the introduction of the sewers. Washington, with a daily individual supply of 177 gallons, has an average annual mortality of 6.2, while New York, with 74 gallons per capita, has 3.1 deaths yearly to 10,000 population. *Abundance* of water alone, as might well be supposed, does not limit the spread of typhoid fever."§

In such cities as have sewerage but still have a contaminated water supply, typhoid fever still remains. Philadelphia is an example. Chicago has been a noted example. Cities like New Orleans where there have been imperfect sewerage, but a water supply from rain-water cisterns not much contaminated by human excreta, do not suffer much from typhoid fever.

Logically it seems to follow that the large part of the typhoid fever must be caused by the typhoid excreta in the drinking water.

There are on record specific instances too numerous to mention where typhoid fever epidemics and local outbreaks have been traced to the use of water infected with excreta of a typhoid fever patient.

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* Page cxlviii.

† Pages cxlix, cli and clii.

‡ Experiments made by Wright and Semple, London Lancet July 27, 1895, Vol. II, No. 4, page 196.

§ Report of Medical Society Dist. of Columbia, in Journal Am. Med. Assoc., Vol. 23, 1894, p. 82.

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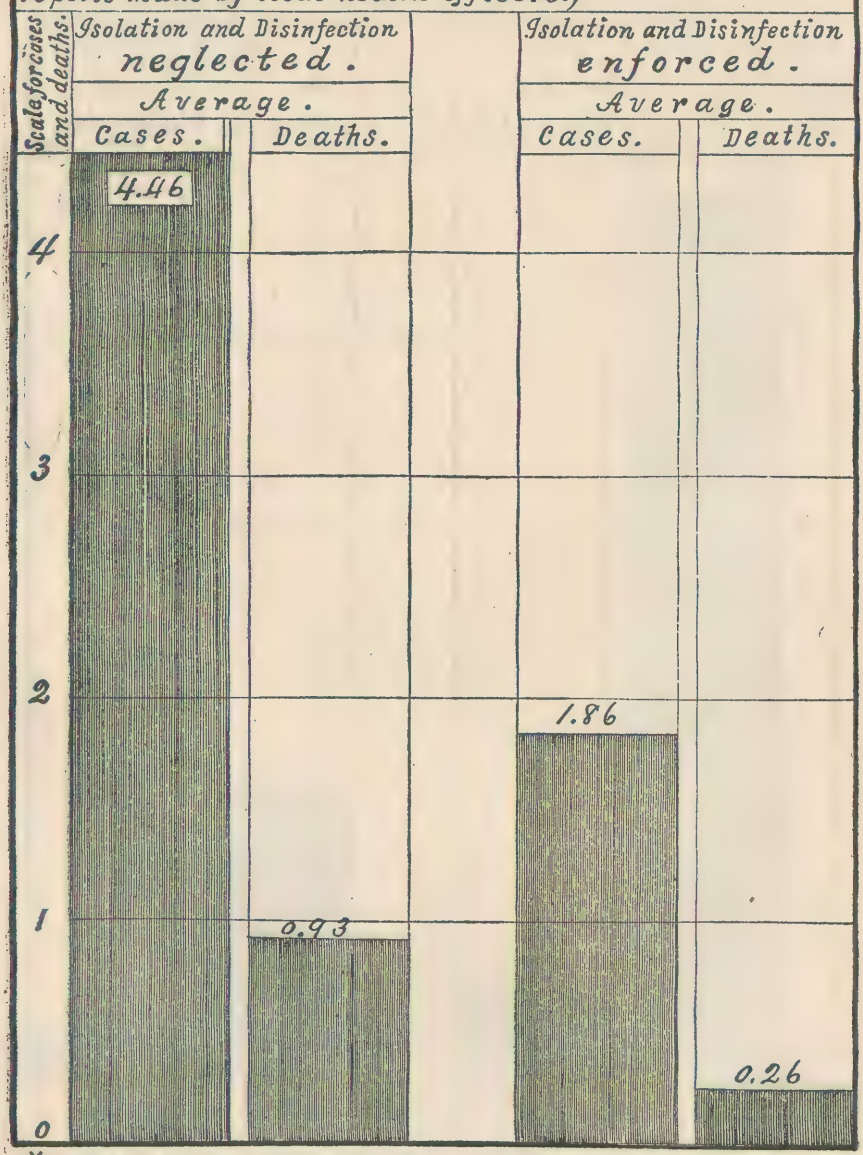

* Including the disinfection of the bowel discharges of the patients.

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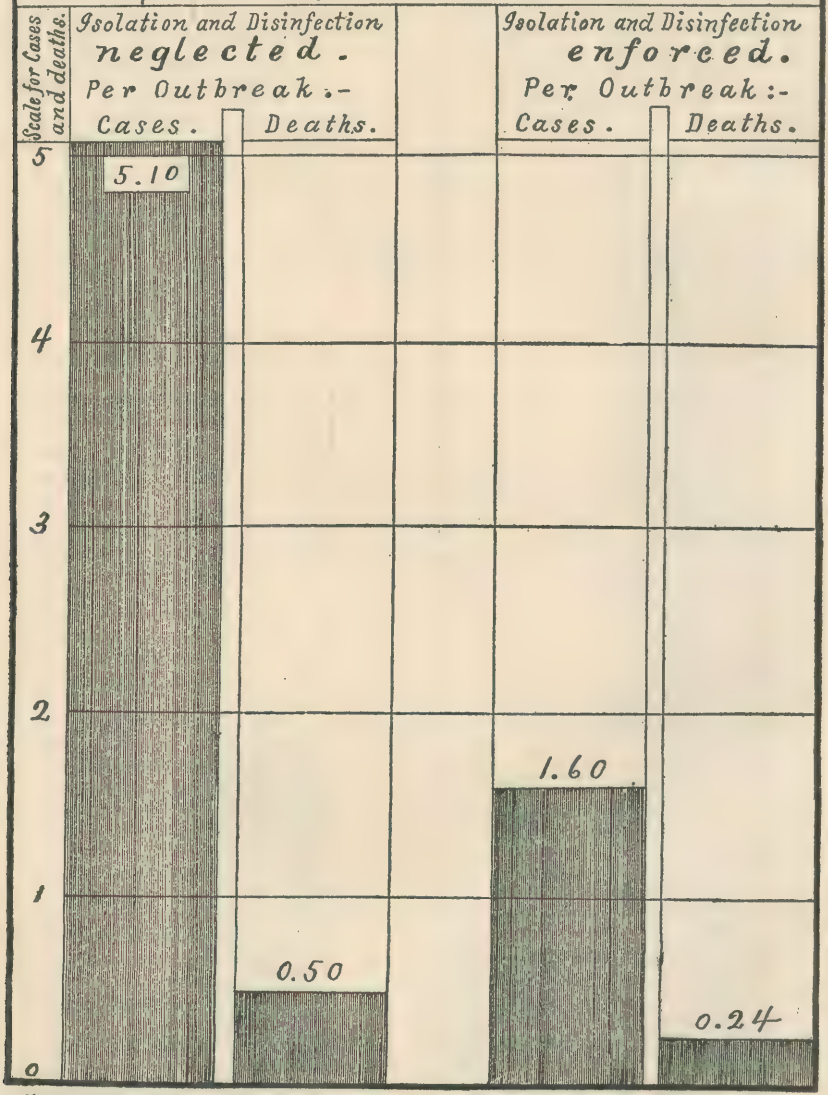
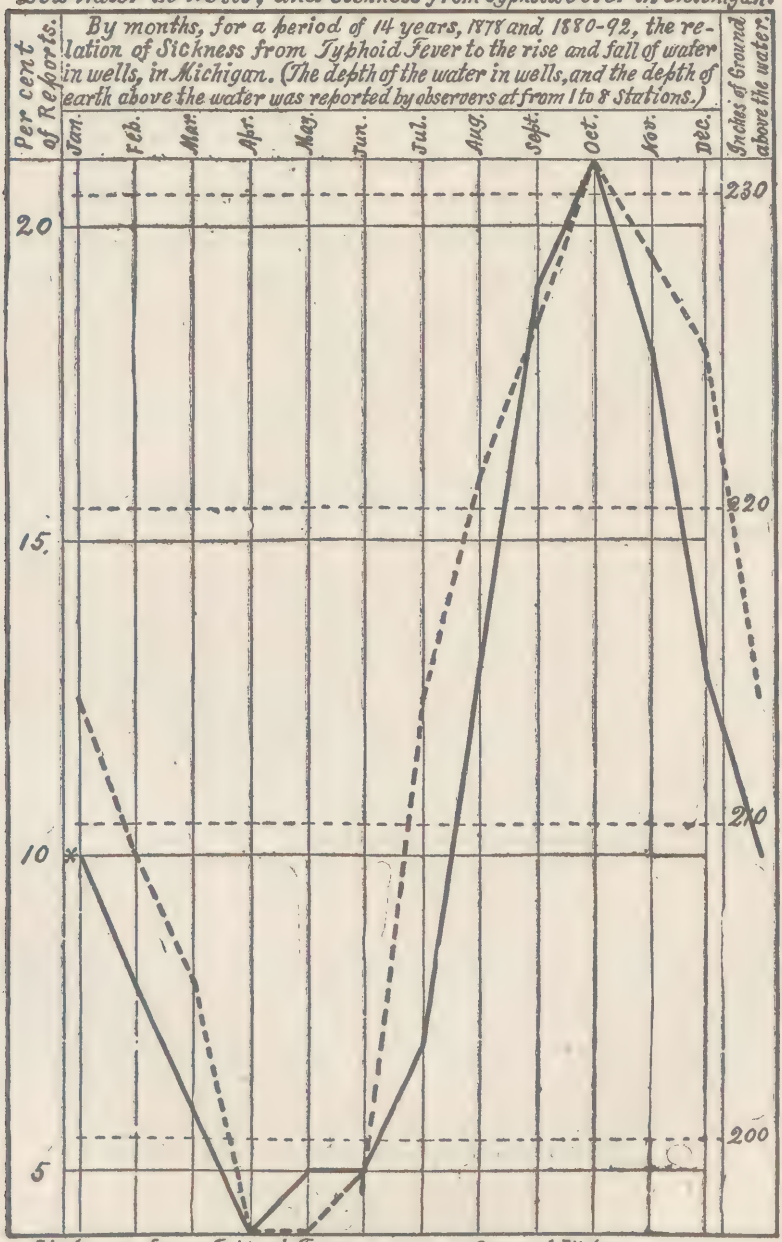
Typhoid Fever in Michigan in 1893:- Exhibiting the average numbers of cases and deaths per outbreak:- in all outbreaks in which Isolation and Disinfection were both Neglected; and in all outbreaks in which both were Enforced.(Compiled in the office of the Secretary of the State Board of Health, from reports made by local Health Officers.)*



* Including the disinfection of the bowel discharges of the patients.

[PLATE 780.]

Low Water in Wells, and Sickness from Typhoid Fever in Michigan.



* Indicating what per cent of all reports received stated the presence of Typhoid Fever then under the observation of the physicians reporting.

The danger from typhoid fever is greatest in October, when the water in wells is lowest, and least in April, when the water in wells is highest.

[PLATE NO. 681.]

Low Water in Wells and Typhoid Fever.

The foregoing leads naturally to an interpretation of the facts concerning the very close relation of low water in wells to typhoid fever in localities dependent upon wells for the water-supply. Many years ago Dr. George E. Ranney, then Secretary, and later President of this Society, called attention to an increase in typhoid fever at a time of low water in wells. Dr. Foster Pratt, also an Ex-President of this Society, spoke, in June, 1874, of a similar circumstance under his observation. With a view of studying the subject systematically, about 20 years ago, I induced regular observations and records of the depth of water in wells in Michigan; five or six years later I tabulated the results, and found a very striking relation. Herewith is a diagram (Plate No. 681)* exhibiting the facts for 14 years, 1878 and 1880–92. It is plain that the relation is very nearly quantitative. The lower the water the more typhoid fever.

Prof. Max von Pettenkofer was the first to make a systematic study of this subject, and he established the fact of a very close relation of typhoid fever and ground water in Munich.† His interpretation of the fact, however, was not that the disease was caused by drinking in the germs with the infected water, as was my belief; but that it was caused by breathing typhoid germ-laden air forced out of the ground by fluctuations of atmospheric pressure. This cannot be the true explanation of the facts in Michigan, because my tables and diagrams show that the average daily range of atmospheric pressure does not sustain such relations to typhoid fever as to make this possible; the range of pressure is at its minimum in July and its maximum in January, while typhoid fever has its minimum in April and May, and its maximum in October; and a curve representing its increase and decrease shows no influence of the atmospheric pressure.

On the other hand, the drinking-water interpretation takes account of the fact that in times of low ground water a well *in use* drains a wider area, and is therefore more liable than in times of high ground water to be infected by leachings from more privies at a distance. Again, it takes account of the fact that any infection which may reach the well will be much more diluted when the ground water is high than when it is low; the chances of contracting typhoid fever are, therefore, greater when the water is low.

There is another interpretation which may be true under some circumstances, not, however, so universal as the drinking-water explanation, but which may contribute toward the same result. When the ground water is low the surface of the earth will generally be dry. Human excreta on the surface of the earth or in shallow receptacles will, more generally than when the ground water is high, be in a condition to permit the wind to detach any typhoid germs which may be on its surface or which may be trampled into dust, and to float them off, to infect air, food or drink, or to be washed from roofs of buildings into the rain-water cistern.

Typhoid Fever Spread by Milk.

Mr. Ernest Hart has collected and tabulated facts relative to 50 outbreaks of typhoid fever spread by milk.

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* Page cliii.

† "Boden and Grundwasser," etc., by Pettenkofer, Munich, 1869.

In the report of the health officer of the District of Columbia for 1895.* Mr. Hart's tabulation is included with 88 other outbreaks collected by Drs. Busey and Kober; altogether there are tabulated the details of date, place, number of cases, deaths, circumstances of outbreak, reporter, and reference to publication, relative to one hundred and thirty-eight outbreaks of typhoid fever in different parts of the world, believed to have been caused by infected milk. (The table, with additions collected by myself, is submitted as an appendix to this paper.)

Many of the outbreaks caused by infected milk were traced further back to infected water, used, in 54 instances for washing the cans and utensils. In 14 instances the intentional dilution of the milk with polluted water is admitted. In six instances the infection is attributed to the cows drinking or wading in sewage-polluted water thus infecting the udder, and finally the milk. In three instances the infection was spread in ice cream prepared in infected premises. In 21 instances the dairy employees also acted as nurses.† In outbreak No. 1 reported by Dr. Taylor, in Edinburg Med. Jour., May, 1858, "the outbreak, which affected 7 families, was traced to a supply derived from a milk-man in whose cottage were cases of typhoid fever. The milk was kept in the kitchen, where the children lay, and the mother, who was the nurse, also milked the cows."*

In a few instances water seemed to have no part in the spread of the disease.

Typhoid Fever Spread by Oysters.

Uncooked oysters "fattened" in typhoid-infected waters are now known to be a means of spreading typhoid fever. An outbreak due to this cause, at Wesleyan University, Middletown, Conn., in October, 1894, was thoroughly investigated, and the results published in the report of the Connecticut State Board of Health for 1894.‡ Two cases of typhoid fever, the discharges from which went through a private sewer into the Quinnipiac River near where the oysters were placed in fresh water to "fatten,"—absorb fresh water—just before they were to be used, were the source and cause of the outbreak. Twenty-three students and six other persons who attended the banquet, contracted the disease.

The general subject of typhoid bacteriology and oysters in salt and fresh waters, at ordinary temperatures, was afterwards investigated by Charles J. Foote, Demonstrator of Bacteriology in Yale University.§ "Many bacilli were found in the oyster juice and in the stomach of the oyster a month after infection, from which it appears that typhoid bacilli may live even longer in the oyster than in the water which surrounds it, from which they usually disappear within three weeks when new infection does not occur."¶

Typhoid Fever Spread by Infected Clothing.

Dr. Kober in the report of the health officer of the District of Columbia, for 1895, page 259, summarizes a report by Gelau as follows: "A German artillery regiment, with an average mean strength of 353 men, between the years 1873 and 1884 furnished not less than 146 cases of typhoid fever.

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* Pages 346-364.
† Page 330.
‡ Report by H. W. Conn, Professor of Biology, Wesleyan University, pp. 243-264.
§ Med. News, Mar. 23, 1895.
¶ Modern Medicine, Feb., 1896, p. 40.

The water-supply was above suspicion, disinfection of the quarters and even abandonment of the barracks failed to check the disease. This finally led to the suspicion that the clothing might be the source of infection, especially as the garments were promiscuously worn. Examination revealed the presence of fecal spots in a number of pantaloons. The clothing was now disinfected, after which only three mild cases appeared, and these were confined to the men engaged in disinfection."

Typhoid Fever Spread Through the Air.

In several instances brought to my notice but not published, typhoid fever has, apparently, been contracted by taking the specific cause into the mouth with the air inhaled. In two such instances the nurses who contracted the disease *slept* in the same room with their patients. Bearing in mind the frequency with which a sleeping person breathes through the mouth, and the fact that then the normal protection of the nose with its moist hairs, disinfecting saline mucus, constantly flowing downward to be evaporated and imprison incoming dust and germs, one may realize the greater liability of a sleeping person to contract typhoid fever. In the Southern States it has many times been observed that yellow fever is much more often contracted by *sleeping* in an infected locality than by visiting it in the daytime.

While investigating an outbreak of typhoid fever in the State Prison at Jackson, I contracted typhoid fever notwithstanding I took no food or water while there. The outbreak occurred soon after a new prisoner had come into the prison, and the disease was apparently spread in more ways than one, but not through the drinking water. A wooden bucket in each cell every night was emptied every morning, and an attempt made to disinfect it by rinsing it with a disinfecting solution; but inspection led me to think that the disinfection was not complete, so it is possible that some of the cases were caused by emanations from an infected bucket, because no effort was made to have the same bucket go to the same cell every night. Among the first persons about the prison to contract typhoid fever, was the guard who was stationed on top of the wall immediately over the place where the buckets were each morning emptied into the sewer, then rinsed and placed in rows to be dried and aired during the day. The typhoid patients were put in the hospital on the fourth floor of the central building, and their dejecta went into a soil-pipe in which there was a break, or from which air could pass through a "dead-end" to a sewer under the lowest floor.

In cells along a line between this source of sewer air and a very large ventilator at the other end of the room, prisoners contracted typhoid fever, so there was reason to believe that the disease was spread through the air from the soil-pipe, on its way to the ventilator. To answer the question whether this was possible, because it was known that micro-organisms are not given off to the air from moist surfaces, a bottle was sterilized, filled with sterilized water, the bottle held in the "dead-end" to the sewer, the water allowed to run out, and the bottle to fill with air from the sewer. While this was being done, the soil-pipe from the hospital on the fourth floor was flushed, foul air rushed out but no fluid or solid came near the bottle. Meantime, with other members of the State Board of Health, I was standing near in conversation with the Warden of the Prison. The bottle was taken by Prof. Vaughan to the laboratory at the University, and I

understand that Prof. Vaughan found the bacillus of Eberth or at least a pathogenic bacillus in its interior. Soon after my return home, I was mildly sick for nearly three weeks, with unmistakable typhoid fever, contracted apparently through the atmosphere.

A few years ago, there was typhoid fever in Iron Mountain, Michigan, and it was especially noticeable to Dr. Anderson, then in that city, that there were most fever cases in houses the rear ends of which were on the three sides of a sort of court in which were numerous foul privies which in wet times drained into a foul pond near the center of the court, but which in a dry time permitted their overflowed contents to be trampled by those who passed through into dust to be blown about by the winds. One windy day, I inspected the locality, and it was easy to understand that if the specific cause of typhoid fever had been deposited in any one of the privies, its dissemination by the wind would be almost certain, because the germ is not rapidly destroyed by drying.

What is the Specific Cause of Typhoid Fever?

Dr. George M. Kober, of Washington, D. C., in a recent report on the subject, after giving different views of the specific cause, has said: "All scientific physicians agree, however, upon one point, viz., that typhoid fever is caused by an organized germ capable of reproducing itself within and without the body."*

Just here, however, is where we arrive at a point in the etiology where differences of opinion exist; for, while a majority of the prominent bacteriologists conclude that the Bacillus typhosus demonstrated in typhoid cadavers by Eberth in 1880, and obtained in pure cultures by Gaffky in 1884, is the sole and only cause of typhoid fever, there are those who regard this as, to say the least, "not proven." Thus, the last edition of "Ptomains and Leucomains" by Vaughan and Novy, says: "In this belief Vaughan refuses to concur, and claims that the Eberth bacillus as found in the spleen after death is an involution-form of any one of a number of germs which are found in certain waters. Vaughan claims that the typhoid bacilli can be detected in drinking-water by the following characteristics: (1) They grow at 37°, while many of the non-pathogenic germs of water grow only at lower temperatures. (2) They are pathogenic to rats, guinea-pigs, mice, and rabbits. (3) They do not coagulate milk. (4) When grown in milk or gelatin colored blue with litmus, the color is not altered."†

THE PATHOLOGY OF TYPHOID FEVER.

A recent writer has stated that the pathology of typhoid fever has long been known, but the etiology has only recently been discovered. In this paper I shall endeavor to omit so much of the pathology as has very long been known, and devote all the time I am permitted to use to the consideration of a few points in pathology which are comparatively new. And, to my mind, there are a number of important facts in pathology which have not very long been known; facts which could not be fully appreciated until considerable progress had been made in the etiology of the disease. For instance, the significance of abscesses, in various parts of the body, could not be appreciated until the bacteriologists had investigated the pus in

* Report of Health Officer of the District of Columbia, 1895, p. 257.
† Edition 1896, page 208.

those abscesses, and found there the apparent specific cause of typhoid fever. A new light is thrown on the pathology of typhoid fever by the knowledge that the specific germ has been found in the blood, and in nearly every organ and tissue of the body. This supports the view that typhoid fever is a disease of general blood infection. New light is supplied by the knowledge that the life-processes of the germs produce a poison, the effects of which, in various parts of the body, are important. Thus "Sanarelli's prolonged studies upon experimental typhoid fever lead him to maintain that the intestinal disturbances in this disease are due to the toxin, and not to the local action of the typhoid bacteria."*

"Agro (Annales de Micrographie, vi., 1894) has discovered the very interesting fact that the mixture of the cultures of bacilli coli and bacillus typhi abdominalis has greater toxic power than a similar quantity of either in pure culture."†

"In 1889 Vaughan isolated from mixed cultures from typhoid stools a base, forming crystalline salts and capable of inducing in cats and dogs a marked elevation of temperature accompanied by severe purging."*

"In 1890 Vaughan reported the isolation, from water supposed to cause typhoid fever, of a number of toxicogenic germs. The chemic products of two of these have been studied. They belong to the proteids, and an analysis of one of them by FREER shows it to belong to the nucleins."‡

In a paper read at the meeting of the American Medical Association at Baltimore, in 1895, William B. Noyes, M. D., of New York, after stating the proportions of children in each of numerous epidemics in Europe and in this country, says: "In conclusion, we would once more emphasize that typhoid in early infancy in a typical form is rare in this country, though not uncommon abroad. It is in a mild or abortive form that we much look for it here, if we wish to separate it from other intestinal or meningeal diseases that may appear."

Dr. Noyes says:—

"The pathologic changes in the infantile cases, while distinct, are much less severe than in adults. It is a very interesting fact that in a series of animal inoculations with typhoid bacilli by Santerelli (*Annals de L'Institute Pasteur, 1892-1894*) the changes in the intestine and other viscera were almost identical with those we have just described in children. These experiments consisted of a series of inoculations of rabbits, guinea pigs, white mice and monkeys with pure cultures of the Eberth bacillus, and were followed by a second series of experiments of inoculations with sterilized filtered products of the Eberth bacillus. The results were similar in the two cases. Swollen hyperemic spleen, congested intestine, diarrheal intestinal contents, infiltrated and congested Peyer's patches, red and hypertrophied solitary follicles. Hardened microscopic sections of the intestine showed a change in the epithelial lining, especially, and detachment of masses of epithelial cells together, such as occurs in a poisoning by arsenic or other corrosive drugs. Enormous infiltration of Peyer's patches occurred, abundant accumulation of lymphoid cells in and around the follicles and invading the submucous spaces. This change was not a simple hypertrophy of lymphatic plaques, but a condition just short of a beginning purulent infiltration. No typhoid bacilli could be found in these Peyer's patches in the animal, but enormous numbers were seen in the adjacent lymphatic glands and in the connective tissue of the mesentery. From these experiments, Santerelli comes to the conclusion that typhoid fever produced in animals is by preference an infection of the lymphatic system, and the toxin produced by the Eberth bacillus causes the anatomic lesions. These changes occur in all mucous surfaces and we should expect to find in both animals and in man, lesions in the mucous membrane of the mouth, larynx, bronchi and stomach with resulting symptoms which occur very frequently. Typhoid fever can no more truly be called a disease of the intestine than small-pox of the skin, though both have their characteristic lesions in those places."—*Jour. Amer. Med. Assoc. Vol. 25, Sept. 28, 1895, pp. 530-31.*

* Jour. Amer. Med. Assoc., Vol. 23, Dec 22, 1894, p. 933.
† Jour. Amer. Med. Assoc., Vol. 23, Dec. 22, 1894, p. 934-935.
‡ Ptomains and Leucomains, 1896, p. 209.

"Stern (*Volkmann's Sammlung klinischer Vorträge, No. 138*) has published another suggestive paper on typhoid." * * * "The question as to the presence of typhoid bacilli in the blood was tested in six cases, with positive results in three; twice in blood from roseolæ and once in blood from a vein. In the negative cases the blood was examined only once in two of the three cases. In the third case, confirmed by autopsy, three examinations were negative. In the cases with positive results the number of colonies was always small, as has been found by other investigators. The bacilli were found between the ninth and twenty-fifth days of the disease. The question whether the blood from the spots or that from the veins is most favorable requires further investigation."*

Otitis in Typhoid Fever.

The hearing is often affected in typhoid fever. "Botkin states as the results of observation in twenty-six cases, that he found in all but five an acute and bilateral inflammation of the outer ear."†

"Peri-articular Abscess due to the Typhoid Bacillus.

"Swiezynsky (*Centralblatt für Bakteriologie und Parasitenkunde*, Band xvi., No. 19, p. 775) has reported the case of a man, 18 years old, with the following sequence of an attack of typhoid fever of considerable severity: swelling and pain appeared in the right arm, followed by redness, tenderness, and fluctuation about the shoulder-joint, although this itself was not involved. In the course of a little while an abscess formed beneath the right deltoid, and an incision evacuated a quantity of pus mixed with blood." * * * "Bacteriologic investigation of the pus evacuated from the abscess about the joint disclosed the presence of typhoid bacilli exclusively."‡

Pylephlebitis and Abscess of the Liver Following Typhoid Fever.

"Lannois has recently described pylephlebitis and abscess of the liver following typhoid, in which the bacillus of Eb-rth was present in the pus from the abscess, though not in pure culture."§

Intrauterine Infection with Typhoid.

"Freund and Levy (*Berliner klinische Wochenschrift*, 1895, No. 25) report the case of a multigravida who was admitted to the hospital in the eighth day of typhoid, being five months pregnant. She progressed favorably until the fourth week, the temperature being but slightly elevated. Without apparent cause she expelled a living fœtus, which soon perished. Her temperature rose during labor, but fell immediately afterwards. The fœtus and placenta were received in sterile glass vessels, and an examination made of the spleen, blood of the heart, and placenta twenty minutes after birth. No gross lesions were found. Typhoid bacilli developed, however, after incubation." * * *

"The case is a remarkable demonstration of the direct passage of infection from mother to child, without anatomical lesions."‖

Suppurative Parotitis Caused by the Typhoid Bacillus.

"To the list of suppurative processes complicating typhoid fever, in which the typhoid bacillus alone has been found as the cause of the abscess

* Amer. Jour. Med. Sci., Vol. 111, March, 1896, pp. 349-350.
† Jour. Amer. Med. Assoc., April 5, 1896, p. 694.
‡ Amer. Jour. Med. Sci., Vol. 109, 1895, p. 328.
§ Amer. Jour. Med. Sci., Vol. 111, March, 1896, p. 347.
‖ Amer. Jour. Medical Sci , Vol. 110, Oct., 1895, pp, 488-489.

formation, Janowski,* has recently (in 1895) added a case of suppurative parotitis."†

"The patient, a young man, had been sick in the hospital seven weeks, during which time he had greatly emaciated; had had more or less fever, and toward the last had developed hemorrhagic nephritis and a tender enlargement of the right parotid gland. The diagnosis of typhoid fever was first made on the autopsy-table, Peyer's patches showing distinct appearances of recently-healed ulceration. The right parotid gland was found to be infiltrated with pus, which was in places collected in small abscesses. Cultures from this pus developed only the typhoid bacillus, whose idenity was carefully proved with comparison of known cultures of the typhoid bacillus and of the *bacillus coli communis*."‡

In a paper read at the meeting of the American Medical Association in 1889, Professor Vaughan, in speaking of the Eberth bacillus, said:—"Gaffky and others found it always present in the mesenteric glands and spleen, often in the liver, and not so frequently in the kidney. In the intestine it has been found in the early stages in the swollen follicles and plaques and in the deeper layers, before there is any necrosis; but with the advent of ulceration there is found secondary invasion. But in addition to these organs, the Eberth germ has been reported by Chantemesse and Vidal in the lungs of typhoid patients with bronchitis, broncho-pneumonia, and pneumonia. The same observers report the germ in the brain, Curschmann in the spinal cord, Zenker and Hoffmann in the voluntary muscles and in the marrow of the bones, and Rehter, Neuhauss and Chantemesse and Vidal in the placenta of typhoid patients. In twenty samples of blood taken from the finger, during life, of typhoid patients, Meisels reports the finding of this germ in nineteen. Neuhauss examined the blood taken from the eruptive spots in typhoid fever with success. Maraglinao and others examine the blood taken from the spleen during life as a means of diagnosis." * * * "Granting that these observers have not been mistaken in the nature of the germ which they have found, we must admit that the Eberth germ is widely distributed."§

In the same paper Dr. Vaughan says: "To sum up the evidence which we have found on this point we may say: (1) The Eberth germ is found invariably in the bodies of those dead from typhoid fever. (2) It has been isolated and grown in pure cultures. (3) All attempts to induce typhoid fever in the lower animals by inoculation with this germ have so far been without success. (4) Experiments show not only that the germs fail to multiply in the lower animals, but that when introduced by inoculation it soon died. * * * But the bacteriologist stops here and says: 'The lower animals do not have typhoid fever, and we must not conclude from the failure to induce this disease in them with Eberth's germ that this bacillus is not the true cause of typhoid fever.' 'If we could experiment upon man,' says he, 'I have no doubt that we could be successful.'"¶

Because the chemical products of the Eberth bacillus had not been demonstrated to be capable of producing the characteristic symptoms and lesions of typhoid fever, Dr. Vaughan then said: "We certainly cannot say that the Eberth germ has been demonstrated to be the true and sufficient cause of typhoid fever."‖

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*Cenralblatt f. Bakt. u Parasitenkunde, 1895, XVII., No. 22,875.
†Am. Jour. Med. Sciences, October, 1895, page 501.
‡Am. Jour. Med. Sciences, October, 1895, page 501.
§Jour. Amer. Med. Assoc., Vol 13, 1889, pp. 831-32.
¶Jour. Amer Med. Assoc , Vol. 13, 1889, pages 832-33.
‖Jour. Amer. Med Assoc., Dec. 14, 1889, page 833.

But in that same address Dr. Vaughan gave details of the inoculation of several dogs with a pure culture of germs resembling the Eberth bacillus, and in several instances the pathological results resembled those of typhoid fever in man. Dr. Vaughan said: "Notwithstanding the marked resemblance of our cultures to those of the Eberth germ, I must conclude from the effects obtained that we either had a wholly different organism or an impure culture."* Other investigators believe that typhoid fever is due to a mixed infection.

Typhoid Bacilli in the Urine; Typhoid Fever a General Blood Infection.

One of the most important ideas, however, is the view set forth by Drs. Wright and Semple, professor and assistant professor of pathology in the British Army Medical School at Netley, based partly upon their experiments on the infectivity of the urine in typhoid fever, which had been previously pointed out by Sanarelli working under the auspices of Metschnikoff, but on which fact Drs. Wright and Semple build up still further Sanarelli's new theory on the pathology of typhoid fever. Drs. Wright and Semple found the typhoid bacillus in the urine of six out of seven cases of typhoid fever. "In some cases the urine, even before incubation, is absolutely turbid with typhoid bacilli."†

They say:‡

"The theory of typhoid fever, which is currently held and currently acted upon, is the theory that typhoid fever is an 'intoxication process' much in the same way as cholera is an 'intoxication process.' In other words it is assumed that the typhoid bacillus vegetates in the intestine, that it effects a lodgment in the intestinal walls and that the poisons which are elaborated by the bacelli are absorbed into the system from the intestine. The systemic disturbance which characterizes typhoid fever is attributed to this absorption. This theory of typhoid fever is brought into harmony with notorious bacteriological facts by the assumption that there is a certain leakage of typhoid bacilli from the intestine into the system. This leakage theory is supposed to dispose of the fact that typhoid bacilli are invariably found in the spleen and mesenteric glands of patients suffering with typhoid fever. Now, this 'intoxication' theory of typhoid fever was originally based upon the fact that a bacillus which is morphologically indistinguishable from the typhoid bacillus is found in large quantities in the stools in every case of typhoid fever. Subsequent investigation, however, showed that this bacillus which predominates in the intestinal floor in cases of typhoid fever can be distinguished from the true typhoid fever bacillus by a series of chemical differences. The bacillus which is found in large quantities in the stools of patients suffering from typhoid fever is therefore not the true typhoid bacillus. It is the bacillus which is known by the name of 'Bacillus coli communis.' Recent research has therefore been directed to the question as to whether, in addition to the bacillus coli communis, the true typhoid bacillus is not also to be found in the stools of patients suffering from typhoid fever. The following are the results of careful examination of this question: The true type of typhoid bacillus was detected in the stools of only four of the twelve cases of typhoid fever which were studied by Wathelet. In the case of these four patients the typhoid bacillus was detected only four times in a total of twenty-four examinations and even on these four occasions the true typhoid bacillus was outnumbered by the bacillus coli communis in the proportion of about three to one. In the case of the other eight cases of typhoid fever the bacillus appeared to be absent from the stools throughout the whole course of the disease. Wathelet has further shown that if the bacillus typhosus and the bacillus coli communis are implanted into one and the same tube of nutrient broth the bacillus coli communis will outgrow and kill off the typhoid fever bacillus even when at the outset an enormous numerical preponderance is given to the typhoid bacillus over the bacillus coli communis. Again, Wathelet has shown that whereas the bacillus coli communis will flourish in a nutrient medium containing the toxins elaborated by the typhoid fever bacillus, the typhoid fever bacillus will not grow in a nutrient medium containing the toxins elaborated by the bacillus coli communis. If this holds true in every case, and it has seemed

* Journal Amer. Med. Assoc., Dec. 14, 1889, page 834.
† London Lancet, July-Dec., 1895, page 199.
‡ London Lancet, July-Dec., 1895, pages 196-9.

to hold true in the few test experiments we have performed, we are evidently in a position to infer on *a priori* grounds that typhoid fever bacilli will be absent from the intestine whenever, as in the case of typhoid fever, we have to deal with the multiplication of the bacillus coli communis in the intestine. Both *a priori* reasons and actual observations therefore point to the absence of typhoid fever bacilli from the intestinal tract, and therefore the symptoms of typhoid fever cannot be interpreted as a result of the absorption of typhoid toxins from the intestine. They seem to ignore the poison of the bacillus coli communis. We are therefore compelled to seek for a new theory for typhoid fever, and if typhoid fever is not the result of an intestinal intoxication process we must evidently seek to explain it as a result of blood infection. This is, if we understand it aright, the theory of typhoid fever which has recently been put forward by Sanarelli, under the auspices of Metchnikoff. We have to see whether typhoid fever can be explained upon the basis of this theory. And evidently the first thing to be explained in the case of typhoid fever is the turgidity of the spleen and the presence of the typhoid bacilli in the splenic tissue. Now, this turgidity of spleen and this presence of micro-organisms in the splenic tissue is an invariable accompaniment of every septicæmic process. We find it in the case of such blood infections as anthrax in cattle and spirillum fever and malaria in man. And we have the explanation of this phenomenon in the experiments of Werigo which show that the introduction of any foreign particulate matter into the blood invariably results in a deposition of that particulate matter in the spleen (and other internal organs), and in an aggregation of polynuclear white blood corpuscles around the foreign particulate matter, and finally in a process of phagocytosis. Every body who has a rabbit and a little carmine, or any bacterial culture at his disposal, can readily verify these facts for himself. The enlarged spleen and the presence of bacteria there are thus quite in harmony with the theory of a blood infection in typhoid fever. The fact that the white blood corpuscles are diminished* in the circulating blood in typhoid fever is also in harmony with this explanation. We have further in connection with typhoid fever to account for the eruption of pink spots on the skin. These were inexplicable on the intoxication theory of typhoid fever. They are, however, of the easiest explanation if we make the assumption that typhoid fever is characterized by a blood infection, for here, as in other cases, we may instance the skin eruption in the case of human glanders; the spots evidently correspond to lodgments of the bacteria in the capillaries of the skin. This interpretation of the skin eruption has been borne out in the case of typhoid fever just as it has in the case of glanders by the fact that the specific bacteria have been cultivated from the spots. We have been able to confirm this observation in one of the cases of typhoid fever reported below.

"The intestinal symptons of typhoid fever are of somewhat uncertain explanation. Possibly they are to be explained as Sanerelli explains them, as a specific effect of the typhoid fever toxin on the adenoid tissue of the intestine, and of the subsequent invasion of that tissue by the bacillus coli communis" * * * "The occasional presence of typhoid bacilli in the intestine is easily accounted for by assuming that a certain number of the typhoid fever bacilli escape through the intestinal wall into the intestinal contents.

"In addition to the points which have just been touched upon, we may refer to other points which, although they have been comparatively neglected, throw an important light upon the pathological processes which are associated with typhoid fever. The phenomena in point are the presence of so-called 'miliary lymphomata' in the kidney and the presence of the typhoid bacilli in the urine. We have no recent opportunity of studying the miliary lymphomata which are described as occurring in typhoid fever, but they are probably quite comparable to the miliary lymphomata which are described as occurring in the spleen in cases of spirillum fever, and to the miliary lymphomata which are produced by the injection of fairly resistant bacteria, such as tubercle bacteria into the blood. Such lymphomata correspond to aggregations of the white blood corpuscles around bacteria which have lodged in the capillaries. They are a repetition in small of the aggregations of phagocytic white blood corpuscles which are seen on a far larger scale in the spleen. Lastly, in regard to the presence of typhoid fever bacilli in the urine. Even if typhoid fever bacilli were found in the urine only in occasional cases their presence there would be a strong argument in favor of the theory of a blood infection and against the intestinal intoxication theory. But the argument in favor of the septicaemic theory of typhoid fever becomes irresistible if it can be shown that the typhoid fever bacilli are almost always found in the urine in cases of typhoid fever. With a view of ascertaining this point we have examined the urine in the following typical cases of typhoid fever."

*"It may be pointed out incidentally here that the paucity of white blood corpuscles in the blood probably stands in some connection with the fact that epistaxis is of frequent occurrence in typhoid fever. This epistaxis, if we may judge from a great many observations which one of us has made of the condition of the blood-coagulability, is almost certainly an indication of a diminished blood-coagulability such as can be obtained by the injection of particulate matter into the blood. In an experiment made by one of us the coagulation time of a dog's blood in the standard capillary tube was reduced from three minutes to fifteen minutes by an intra-vascular injection of carmine particles.

The Journal of the American Medical Association summarizes the conclusions of Drs. Wright and Semple as follows:*

"1. It is true that the typhoid bacilli are present in the urine of patients suffering from typhoid fever, and if, as we shall see, typhoid bacilli are generally absent from the feces, it will be evident that it is the urine, and not the feces of patients suffering from typhoid fever which is responsible for the spread of typhoid infection.

"2. If typhoid bacilli are constantly present in the urine of typhoid patients it may be possible to diagnose the presence or absence of typhoid fever by undertaking a bacteriologic examination of the urine.

"3. If it is true that typhoid bacilli are constantly present in the urine in cases of typhoid fever while they are generally absent from the feces, it will be evident that the conception of typhoid fever upon which the ordinary clinician proceeds is an entirely erroneous one.

"4. The working hypothesis regarding this fever in the minds of medical men generally, favoring as it does the notion that this fever is an intestinal intoxication process, should be revised, and substituted for it one that will have regard to the wide range of pathologic appearances, some of which at least fit in well with a hypothesis of blood infection, such as malarial fever in man and anthrax in cattle."

While most of the views expressed by Drs. Wright and Semple seem to me to accord with the facts, a few important discrepancies are noticeable,

(1.) From several lines of evidence it is apparent that the infection of the body by typhoid fever is primarily by way of the alimentary canal: therefore, the "assumption that there is a certain leakage of typhoid bacilli from the intestine into the system" appears to be true in fact. This, however, does not negative their assumption that later there may be a "leakage" from the general circulation and the tissues into the intestine.

(2.) Inasmuch as the common bacillus of the colon is increased in typhoid fever, and in its life processes produces a poison which when mixed with the product of the typhoid bacillus has increased toxic power,† intestinal antiseptics in typhoid fever may yet be important, notwithstanding the contrary suggestion of Drs. Wright and Semple, so that, although we may come to rely upon the poison of the bacillus coli communis to destroy the typhoid germs, instead of substituting for the intestinal intoxication theory, there may be added to that doctrine the idea of general blood and systemic infection, which seems to be well established by the independent observations of a very great number of investigators.

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* Jour. Amer. Med. Assoc., Oct. 5, 1895, p. 589.

† Agro, Annales de Micrographie, vi, 1894: Jour. Amer. Med. Assoc , Vol. 23, pp. 934-935, Dec. 22, 1894.

APPENDIX.

NOTE.—In this appendix, 171 outbreaks of typhoid fever believed to be due to contaminated milk are grouped. The first 49, collected by Ernest Hart, and the succeeding 89, collected by Drs. Busey and Kober, are taken from the appendix of the Report of the Health Officer of the District of Columbia for 1895. The succeeding 9 were collected by Henry B. Baker, M. D., Secretary of the Mich. State Board of Health. The remaining 24 were collected by Dr. Rowland Godfrey Freeman, and published in his pamphlet, "Milk as an Agency in the Conveyance of Disease." In his pamphlet, however, Dr. Freeman cites 53 outbreaks, 29 of which are previously mentioned in this appendix as collected by Drs. Busey and Kober.

Epidemics of Milk-Typhoid. (Hart.)

No.	Date.	Place.	No. of cases.	No. of deaths.	No. of cases among milk consumers.	Per cent.	Circumstances of the outbreak.	Reporter and reference.
1	Oct. and Nov., 1857	Penrith	------	----	------	----	The outbreak, which affected 7 families, was traced to a supply derived from a milkman in whose cottage were cases of typhoid fever. The milk was kept in the kitchen, where the children lay, and the mother, who was the nurse, also milked the cows.	Dr. M. W. Taylor, Edin. Med. Jour., May, 1858; Brit. Med. Jour., Vol. II, 1870, p. 623.
2	July and Aug , 1870	Islington (part of)	175	30	175	100	No evidence of typhoid fever at the premises; there was an underground water tank at the milk shop, communicating by means of rat burrows with two old drains, possible overflow of sewage from these into the tank, from which the water was used to wash the milk cans.	Dr. E. Ballard, M. O. H., Brit. Med. Jour., Vol. II, 1870, p. 589. Med. Times and Gazette, Vol. II, 1870, p. 611.
3	July and Aug., 1872	Armley, near Leeds	107	11	------	----	Traced to a milk farm where typhoid occurred in May, dejecta suspected to have been thrown on dung pit; in the latter part of the patient's illness copious rains fell and probably washed the germs from the pit or polluted soil into the well, as about this time the cause of the fever began to operate among consumers of milk.	Dr. E. Ballard, M. O. H., Reports Medical Officer of privy council and local government board, Vol. II, 1874, p. 79.
4	Oct. and Nov., 1872	Leeds	93	14	80	86	Typhoid fever at milk farm since September. Water supply pure, sick room communicated with kitchen and dairy, and the air of these premises common. Kitchen drain communicated with manure heap, and the privy, which received typhoid excreta, was overflowing.	Dr. M. K. Robinson, M. O. H., Brit. Med. Jour., Vol. I, 1873, p. 68.

5	Nov. and Dec., 1872	Moseley and Balsall Heath.	96	10	----	----	A case of what was no doubt typhoid fever occurred in a house located between two milk sellers; dejecta thrown into the privy from which the virus must have found access to the water of the milk sellers' wells. One of them polluted the milk, the other made no profession of selling it pure.	Dr. E. Ballard, M. O. H., Report Medical Officer local government board, No. 11, 1874, p. 92. Brit. Med. Jour., Vol. I, 1873, p. 68.
6	Jan., 1873	Parkhead, Glasgow	39	6	46	86	Typhoid fever at dairy among the children in December. Milkers also nursed the affected children.	Dr. J. B. Russell, M. O. H., Glasgow Med. Jour.
7	April, 1873	Chester.	15	----	15	100	Cases of fever at the milk shop in the latter part of 1872. A grocery and provision shop used also as a milk house.	Dr. E. Waters.
8	July and Aug., 1873	Marylebone and adjoining districts.	244	26	218	89	Occupant of milk farm died June 8 of ambulant typhoid fever; dejecta buried in an ash heap, the soakings from which must have found access to the well used for dairy purposes.	Dr. J. N. Radcliffe and W. H Power, Report Medical Officer local govt. board, No. 11, 1874, pp. 103-136; Brit. Med. Jour., Vol. II, 1873, pp. 206, 207, 296.
9	July, 1873, to Nov., 1877.	Ascot	69	----	58	84	No case of typhoid occurred at the milk farm till August, 1876, when the epidemic had lasted for three years. Contagion originally reached farm probably through the water entering the well in the yard, carrying the germ from elsewhere, after which the water used for washing milk utensils had an opportunity of specific pollution at the farm.	Dr. E. Ballard, Brit. Med. Jour., Vol. I, 1880, p. 83; Report Med. Officer local government board for 1877, p. 39.
10	August, 1873	Brighouse, Yorkshire	68	8	65	95	No typhoid fever at milk farm or dairy; cows healthy, but drank from a cess pool. Complaints of milk smelling badly and becoming offensive after standing awhile.	Dr. T. Britton, M. O. H., Brit. Med. Jour., Vol. II, 1873, pp. 267 and 334.
11	August, 1873	Wolverhampton	63	14	----	----	Two children of dairyman sick with typhoid fever in August. Well within a few inches of an old flat-bottomed brick sewer. Epidemic stayed by cutting off the supply of pump water by this milkman.	Dr. J. H. Love, M.O. H., Brit. Med. Jour., Vol. II, 1873, pp. 267, 290, 334, 447.
12	May and June, 1874	Brierly Lane	65	4	50	76	First person attacked was the dairyman. Wife nursed him and milked the cows. The dairy well upon analysis was found 'little better than filtered sewage.' No evidence, however, of specific pollution.	Dr. R. T. Thorne, Brit. Medical Jour., Vol. II, 1874, p. 391; Sanitary Record, Vol. I, 1874, p. 214.
13	June, 1874	Taunton	5	----	5	100	No evidence of typhoid fever at the source of milk supply. Well water of the dairy subject to "fearful contamination with the sewage."	Dr. H. J. Alvord, M. O. H.
14	August, 1874	Queensbury	36	1	34	94	Farmer's wife sickened of typhoid during outbreak. Well close to house; drain roughly made of stone. Earth between drain and well saturated with sewage.	Ann. Report of Med. Officer of Health for 1874.

Epidemics of Milk-Typhoid. (*Hart.*)—CONTINUED.

No.	Date.	Place.	No. of cases.	No of deaths.	No. of cases among milk consumers.	Per cent.	Circumstances of the outbreak.	Reporter and reference.
15	Oct. and v. 1874	Dundee	19	4	19	100	Typhoid fever cases at farm; 4 patients occupied a bedroom adjoining the milk store. Well water reported to be contaminated with the products of decomposing organic matter of the nature of sewage.	Dr. G. C. Pirie, M. O. H., Brit. Med. Jour., Vol. I, 1875, p. 225.
16	Feb. and Mar., 1875	Crosshill, Renfrewshire.	153	----	------	----	Two of the farm children had suffered from the disease; dejecta thrown either in the manure heap or into the ditch. Nurses also connected with the collection and disposal of the milk. Well water quite impure.	Drs. H. D. Littlejohn and E. Duncan, Brit. Med. Jour., Vol. I, 1875, p. 391. Sanitary Record, Vol. II, 1875, p. 61.
17	August, 1875	Jarrow	34	2	31	91	Six of the farmer's family, including himself, found ill with typhoid. Direct communication between dairy and sick room. Dairy also used as a wash house. The daughter acted as nurse and milkmaid.	Dr. John Spear, M. O. H., Brit. Med. Jour., Vol. II, 1875, p. 372. Sanitary Record, Vol. III, 1875, p. 195.
18	September, 1875	Glasgow [1]	2 59	3	58	98	Two cases of typhoid at farm. Washing for patients done on August 3, 10, and 27, in a wash house closely situated near pump well. Water quite impure.	Dr. J. B. Russell, M. O. H., Brit. Med. Jour., Vol. II, 1875, p. 535.
19	September, 1875	Glasgow [3]	121	3	98	81	Traced to same milk supply as epidemic No. 18	Do.
20	Jan. and Feb., 1876	*a* Eagley and Bolton	105	13	------	----	No typhoid fever cases at farm, which, however, depended for its water supply upon a brook which had been fouled with the excrement of men engaged in building a mill 200 yards off. There was evidence that some individual who had used the stream had suffered from diarrhea.	Dr. W. H. Power to local government board. J. Robinson, M. O. H., Brit. Med. Jour., 1876, pp. 201, 233, 273, 293, 491.
21	Autumn, 1876	Churwell and Morley	(4)	9	------	----	A case of fever at the farm; well water unfit for drinking purposes, but farmer denied having used it for dairy purposes.	Dr. J. G. Clark, M. O. H.
29	February, 1876	*b* Bolton	144	8	------	----	See No. 20.	
		Greenock	20	----	------	----	A farmer allowed a case to be brought into his house and after awhile 3 servants and several members of his family were taken sick with enteric fever, and communicated the disease to over 200 consumers of milk.	Brit. Med. Jour., Vol. I, 1876, p. 425. Sanitary Record, Vol. IV, p. 234.

22	Nov., 1876	Great Coggeshall	28	----	28	100	Imported case of typhoid fever at dairy, dejecta thrown into a drain emptying into a brook which was used for dairy purposes.	Dr. R. T. Thorne, Official Report.
23	Dec , 1876	Salford	13	----	13	100	Sixteen cases of typhoid at the farm within twenty years. Well close to a privy cesspool, and a yard or so off was a sink for dirty water.	Dr. J. Tatham, M. O. H., Ann. Rep. of Med. Off. of Health for Salford, 1875-76.
24	Dec. and Jan., 1876-77	Barrowford, Lancashire.	57	7	57	100	Recent cases of typhoid at farm. Milk tins washed with the same dish cloth as used among fever patients; farmer nursed children and milked cows.	Dr. T. Dean, M. O. H., Medical Times and Gazette, Vol. I, 1877, p. 72.
25	1877	The Gurnos Ystalyfera.	7	----	7	100	Milk dealer's son sick with typhoid fever. Milk stored in a pantry leading out of the living room of a small, overcrowded house.	Dr. H. L. Parsons, Rep. on Sanitary Conditions of Ponkardarve rural sanitary district, 1880.
26	Jan., 1877	Greenock	20	2	16	80	No details	Dr. J. Wallace, M. O. H., Brit. Med. Jour., Vol I, p. 108.
27	Feb., 1877	St. Pancras, part of the northeast district of parish.	35	2	30	85	Sudden and explosive outbreak traced to a milk supply, with no evidence of enteric fever at milk shops or farms. Water supply contaminated with filth.	Dr. T. Stevenson, M. O. H., Brit. Med. Jour., Vol. I, 1877, pp. 275 and 329.
28	Aug., 1877	Edinburgh, Coltbridge.	.....	(5)	.....	---	A case of typhoid fever at dairy communicated the disease to over twenty families.	Brit. Med. Jour., Vol. II, etc., 1877, p. 392.
29	Oct. and Nov., 1877	Tunbridgewells	68	----	.....	---	Milk supplied from various sources; no typhoid fever at the farms, but at one of them the sewage of the town flowed through the cowyard; in the village there had been cases of typhoid fever.	Dr. W. H. Rix, M. O. H.
30	Dec. and Jan., 1877-78	Glasgow and Hillhead.	166	16	.....	----	Typhoid fever at 1 of the supplying milk farms; nursing performed also by dairy hands, dejecta thrown into a channel running on each side of the central passage provided in byres for cattle droppings From the middle of the byre the washing house was entered, and through this the milk-house.	Dr. J. B. Russell, M. O. H., Brit. Med. Jour., Vol. I, 1878, pp. 101, 165, 270.
31	Jan. to Mar , 1878	Morsside near Manchester.	32	3	29	90	Two deaths from typhoid at farm in February. Well in close contiguity to ash pits, and water found to be sewage polluted.	Dr. E. Sutcliffe, M. O. H., Med. Times and Gazette, Vol. I, 1878, p. 517.
32	July and Aug., 1878	Bristol[6]	131	12	131	100	A young lady visited the farm in June, just convalescing of typhoid fever. One of the farm servants ill Aug. 1. Cesspool overflowing and its contents were traced by a recurrent course to well, which was used for dairy purposes.	Dr. D. Davies, M. O. H., Brit. Med. Jour., Vol. II, 1878, p. 226. Sanitary Record, Vol. II, 1878, pp. 100-166.
33	Aug., 1878	Croydon	48	----	37	77	A sudden and explosive outbreak traced to a milk supply, but no evidence of enteric fever at the source of supply.	Dr. C. W. Philpot, M. O. H., Ann. Report, 1878. Brit. Med. Jour., Vol. II, 1879, p. 675.

[1] Washington street epidemic. [2] And 30 suspicious cases. [3] Pollock Shaw's road and Kingston epidemics. [4] A great number. [5] Several deaths.
[6] There was also a supposed outbreak of milk typhoid at Bristol, 8 cases in 5 houses in spring of 1880. Their common milk supply was the only connection.

Epidemics of Milk-Typhoid. (*Hart.*)—CONTINUED.

No.	Date.	Place.	No. of cases.	No. of deaths.	No. of cases among milk consumers.	Per cent.	Circumstances of the outbreak.	Reporter and reference.
34	Sept., 1878	Portsmouth	153	----	78	64	Farmer's children had typhoid fever and no doubt poisoned the well, for two children who were out walking and drank water from this well were subsequently attacked. Milk supplemented from another farm where well was within a few feet of cesspool of a common privy.	Dr. G. Turner, Brit. Med. Jour., Vol. II, 1879, p. 675.
35	Sept., 1878	Colston near Glasgow.	40	----	40	100	Infected clothing brought to a dairy farm to be washed. On the 14th and 15th days later, symptoms of enteric fever appeared in persons receiving milk from this farm; also a convalescing child brought to farm. Water supply on premises deficient; shallow dip well, but not used for drinking purposes.	Dr. J. Christie, Sanitary Record, Vol. IV, p. 342.
36	Oct., 1878	Perth	(1)	----	------	----	All the families in which the disease appeared had their milk from one dairy.	Brit. Med. Jour., Vol. II, 1878, p. 645.
37	Dec. (Christmas), 1878	Dublin	------	----	67	100	A probable case of typhoid at dairy in November and middle of December. "A strong wind blowing into the yard would certainly waft particles of coal ash, etc., from the dung heap; to these minute portions of human excreta might have adhered." Nurses also connected with dairy.	Dr. C. A. Cameron, M. O. H., Dublin Jour. of Med. Sci., July, 1879, Pt. I.
38	Nov., 1878	Huncoat	12	----	12	100	Children of farmer sick with typhoid fever. Father would nurse the children and also attend to the cattle.	Dr. T. Dean, M. O. H., Sanitary Records, Vol. IV, p. 362.
39	Feb., 1879	Chichester	50	6	------	----	Milking hovel near a stream which received large quantities of filth. Milkmen washed udders of cows with water from the stream, which probably at the time contained the specific poison. Privy pit only 8 yards from well, but no history of any recent typhoid at the farm.	Dr. Hubert Airy, Brit. Med. Jour., Vol. II, 1879, p. 475.
40	Oct., 1879	Bristol	(1)	----	------	----	Milk traced to a suspected farm where there was no enteric fever, but water from pump in a dairy absolutely stunk when pumped, and was described as "simply poisonous."	Dr. Davies, M. O. H., Brit. Med. Jour., Vol. II, 1879, p. 625.

41	Jan., 1880	Penzance	26	4	26	100	Three cases of typhoid at the farm. The same person who milked the cows and attended to washing of dairy utensils, also nursed the patients.	Dr. G. B. Millett, M. O. H., Brit. Med. Jour., Vol. II, 1880, p. 37.
42	April, 1880	Glasgow	508	69	373	73	Dairymen of the farm sickened with enteric fever in March. Subsequently some of the children took sick and lay in bedroom next the kitchen; also dairymaid was taken sick and occupied a room above milk and wash house. Soiled discharges from sick bed washed at dip well, probably also used for other domestic purposes.	Dr. J. B. Russell, M. O. H., Brit. Med. Jour., Vol. I, 1880, p. 985.
43	April, 1880	Possilpark, Glasgow	92	----	90	97	(See above, No. 42.) Dairyman supplied milk shops in Possilpark also.	Dr. J. Christie, Brit. Med. Jour., Vol. I, 1880, p. 864.
44	July to Sept., 1880	Millbrook, Cornwall	19	----	19	100	Six cases of typhoid within three weeks at milk seller's house; milk kept in a filthy apartment near a badly trapped and very offensive drain inlet, which drain communicated with another which had received infected excreta.	Dr. E. Ballard, Brit. Med. Jour, Vol. I, 1881, p. 20.
45	Sept, 1880	Rochdale	35	9	26	74	In a cottage between the farmhouse and shippen[2] a woman had been suffering from typhoid fever, her excreta were thrown over the wall opposite the door into a cesspool, from which the dip of the soil inclines toward farm well. Cattle also waded about this cesspool. Milk probably diluted.	Dr. Joseph Henry, M. O. H., Brit. Med. Jour., Vol. II, 1880, p. 597.
46	Sept. and Oct., 1880	Portsmouth, Cambridge Barracks.	7	----	7	100	Milkman's son had fever with typhoid symptoms in a room upstairs, and dejecta had to be carried through the back kitchen, also used as a dairy. Infection being caused by absorption or by the act of milking being performed by attendants on the sick boy.	Surg. Maj. Jameson, Brit. Med. Jour., Vol. I, 1881, p. 61.
47	Oct, 1880	Bridlington	48	8	48	100	Convalescent from typhoid fever visited the dairyman's house, probably in September. The outbreak occurred in the early part of October. Dairy well close to manure pile; privies only 13 yards distant, water evidently largely contaminated by sewage.	Dr. J. Allison, M. O. H.
48	Oct, 1880	Marylebone, Clifton Hill, etc.	9	9?	1?	100	Nil. All cases occurred about the same date. Invaded houses not on the same side of the street, nor adjacent. Five out of six households invaded had their milk from one dealer.	Dr. A. W. Blyth, M. O. H., Brit. Med. Jour., Vol. I, 1881, p. 61.
49	Oct., 1880	Southport	32	2	32	100	No typhoid fever at a dairy, but well in close proximity and exposed to excremental pollution; water declared to be nothing but liquid sewage.	Dr. H. H. Vernon, M. O. H., Brit. Med. Jour., Vol. II, 1880, pp. 820-934.

[1] Several cases. [2] Cowhouse.

Epidemics of Milk-Typhoid. (*Hart.*)—CONTINUED.

(Outbreak No. 50 and the succeeding 88 were collected by Drs. Busey and Kober.)

No.	Date.	Place.	No. of cases.	No. of deaths.	No. of cases among milk consumers.	Per cent.	Circumstances of the outbreak.	Reporter and reference.
50	Oct. and Nov., 1880	Worthing	44	8	44	100	A case of enteric fever in the house; excreta thrown into a defective drain, which was near the well used for dairy purposes; distinct evidence of soakage from the drain into well.	Dr. C. Kelly, M. O. H., Brit. Med. Jour., Vol. II, 1880, p. 934.
51	1868	Dover	----	----	----	----	Investigation convinced reporter that the milk was the vehicle of the poison and that it became infected by absorption and not through contaminted water.	Dr. M. K. Robinson, Trans. Int. Congress for Hygiene and Demogr., 7th session, 1891, sec. 3, p. 170.
52	Aug. 28 to Sept. 3, 1872	Bergen	(1) 8	----	All	100	Enteric fever at farm. Wife acted as nurse and distributed the milk. Explosive outbreak. All cases taken sick between Aug. 28 to Sept. 3.	Dr. Holmloe, Nork Mag. f. Laegerk, 1873, p. 654; Hirsch Handbuch, Vol. I, p. 683.
53	Summer, 1875	Plon Holstein	(2)	----	----	----	Enteric fever at milk farm. Well highly polluted with refuse. Water used for cleaning milk utensils. No new cases after Sept. 5, when customers stopped purchasing milk, except in one family, who continued to buy the milk.	Dr. Lübe, Allegem, Zeitschft f. Epidem., 1876, Vol. II, p. 2t8.
54	Nov., 1878	Aberdeenshire	(2)	----	----	----	Piggery close to milk room; bad drain passed under the pump, whence the water for household was procured.	F. A. McEuen, London Practit., 1881, XXVI, 161-164.
55	Jan., 1879	Do.	15	----	----	----	Utensils washed from a well close to and under the level of the dung hill, and open to any sewage that might percolate in that direction.	Do.
56	Jan., 1881	----	(2)	----	----	----	Refers to several instances in which "milk had been liable to contamination either directly through persons suffering from the disease or indirectly through sewer emanations of water charged with the specific infective element of the disease for which the milk may also have acted as a cultivation fluid."	Dr. W. N. Thursfield, Sanitary Record, London, 1880-81, n. s. II, 243.
57	March, 1882	Leicester Infirmary	12	2	12	100	A fatal case of typhoid fever at dairy. Polluted well. All patients had used unboiled milk.	W. Elgar Buck, Mid. Med. Misc., Leicester, 1883, II, p. 73.

58	May and June, 1882	Glasgow	59	6	50	85	Nearly all cases occurred within one week in May. None since June 1, "and its area has been most distinctly marked out in relation to the milk supply."	Dr. J. B. Russell, M. O. H., Brit. Med. Jour., Vol. II, 1882, July 8.
59	June, 1882	Allegheny City, Pa.	40	4	.....	....	Typhoid fever at dairy. Well only 50 ft. from privy vault; the latter was full and higher upon the hill than the well.	Dr. D. N. Rankin, Pittsburg, Med. Jour., 1883, III, 289-292.
60	June, 1882	Clapham	20	....	19	95	All cases taken sick within 24 hours; all supplied with one exception, with milk from same dairy; health officer unable to explain milk infection.	Brit. Med. Jour., 1882, Vol. II, p. 216.
61	July, 1882	Halifax Stone Chair	11	1	11	100	Two cases of probable typhoid at farm. Father of farmer's wife arrived July 11, taken sick July 21; no medical attendant. His wife came to nurse him Aug. 14; taken sick Aug. 21; died Sept. 6. Unsanitary condition of farm; untrapped drain in room where milk was stored; polluted water.	Dr. Britton, Brit. Med. Jour., 1882, Vol. II, p. 749.
62	Nov., 1882	Newton Heath	60	....	.....	....	Of the first 16 cases, 12 consumed milk from the same dairy; 2 obtained their milk from shops and 2 from still other sources; no details, doubtful connection.	Henry Tomkins and James Niven, London Lancet, 1883, Vol. I, pp. 360, 641.
63	July, 1883	Göteborg	4	....	4	100	Typhoid fever at milk farm and unsanitary conditions.	Dr. E. Almquist, Vrtljschr. f. Gesundhtspfl., 1889, XXI, 327.
64	Jan., 1883	Cologne	270	....	.....	....	The cases were distributed in 54 households, all situated in the best part of the city. Typhoid among servants at milk farm; polluted water used in cleaning utensils.	Dr. B. Auerbach, Deutsche Med. Wochenschft., Berlin, 1884, X, 709.
65	Feb., 1883	Gateshead	44	6	44	100	All in 30 households supplied with milk from a farm where enteric fever prevailed among the children; the mother nursed and also assisted in milking and dairy work. Utensils kept in a dirty scullery.	Chas. Green, London Lancet, 1883, Vol. II, 986.
66	July to October, 1883	St. Pancras	431	62	368	....	Epidemic invaded 276 families, all using milk from a particular dairy farm where enteric fever started in a boy who arrived July 6, and sickened July 16.	Shirley F. Murphy, London Lancet, '83, Vol. II, p. 652.
67	Oct., 1883	Dundee	102	....	36	....	Disseminated by the sale of milk from a dairy kept by a man of whose family several members were sick with typhoid fever.	Brit. Med. Jour., 1883, Vol. II., p. 839.
68	Oct. and Nov., 1883	Englewood, N. J.	10	....	10	100	Typhoid fever case at dairy; a woman who assisted in nursing also helped to wash milk utensils.	D. A. Baldwin, Med. Record, N. Y., 1883, XXIV., p. 585.
69	Oct. and Nov., 1883	Port Jarvis, N. Y.	159	17	(3)21	80	Three cases of typhoid at milk farm in August and September. The bulk of epidemic cases occurred between October 24 and Nov. 15, the sale of milk having been stopped Nov. 4.	Dr. A. P. MacDonald, N. Y. Med. Times, 1883-84, XI., p. 328.

[1] Families. [2] Several cases. [3] Either this number or the per cent in next column is probably wrong. H. B. B

Epidemics of Milk-Typhoid. (*Busey and Kober.*)—CONTINUED.

No.	Date.	Place.	No. of cases.	No. of deaths.	No. of cases among milk consumers.	Per cent.	Circumstances of the outbreak.	Reporter and reference.
70	Dec., 1883	Aberdeen	25	2	25	100	Daughter of the owner of the milk farm reported to have been ill with diarrhea; water from an open ditch polluted with sewage and the dejecta of a previous case of typhoid fever, located above the farm, had been used for dairy purposes. Milk supply diluted.	Dr. Simpson, M. O. H., London Lancet, Vol. I, 1884, p. 487.
71	Jan. and Feb., 1884	Upsala, Lakare Forën	42	----	42	100	Typhoid at milk farm and bad, unsanitary conditions.	Ernst Almquist, Vrtljschr, f. Gesundhtspfl., 1889, XXI., 327.
72	May and June, 1884	St. Albans	131	23	------	----	Of 396 houses supplied with the suspected milk, 86, or 21.7 per cent, were infected. Some of the milk sent to London affected consumers there. Milk obtained from a farm where cases of typhoid had occurred.	S. F. Murphy, Rep. Med. Off. local govt. board, 1884, Brit. Med. Jour., 1884, Vol. I., 1162, Vol. II., p. 1086.
73	October, 1884	Tweedmouth	23	----	23	100	All due to milk sold while there was typhoid fever at cow keeper's house, for which he was fined 3 guineas.	Sanitary Record. London, n. s., 1884-85, p. 204.
74	August and Sept., 1884	Belvidere, Royal, and Western infirmaries, Glasgow.	143	32	------	----	Traced to a particular milk farm where dairy maid took sick at the same time as the outbreak in Glasgow. Prior to this cattle had suffered from febrile disease, attributed to drinking sewage water; enteric fever epidemic in adjacent villages; difficult to say whether infection originated with the cows or had been conveyed from another focus.	Dr. J. B. Russell, M. O. H., Brit. Med. Jour., 1884, II, 626, 724. Sanitary Jour., Glasgow, 1884-85, n. s., VIII, pp. 225-239.
75	October, 1884	Derby	40	----	40	100	Sudden outbreak among customers of a particular dairy, where 4 cases of typhoid fever had previously occurred. Well liable to gross pollution, being situated on the brink of a ditch which rec'd the drainage from the farm house.	Brit. Med. Jour., 1884, Vol. II, p. 786.
76	Nov., 1884; Mar., 1885	Groningen	58	----	46	79	Infected well at dairy	Dr. Ali-Cohen. Nederl. Tijdschr. v Geneesk., Amster., 1887, XXIII., 2d, pp. 78, 84.
77	Dec , 1884	Aberdeen	65	7	43	66	Numerous sources of contamination at the milk farm; well polluted.	Dr. Simpson, Brit. Med. Jour., Vol. I., 1885, p. 193.

78	Feb., 1886	Leichhardt, Australia	38	5			Sewerage polluted well at dairy	J. Ashburton Thompson, Austr. Med. Gazette, Sidney, 1885-6, Vol. V., p. 265.
79	July, 1886	Swanage Dorset					This epidemic of typhoid fever at its commencement was associated with the use of milk from a dairy, situated near a polluted brook, and no other water supply was on the premises.	Mr. W. Harvey, Rep. Med. Off. local govt. board, 1886, No. 16, p. 294.
80	July, 1886	Lancing College, Shoreham.	14 80–100	2	14	100	Outbreak originally traced to cream derived from a certain dairy, where no other evidence could be found than a liability of the well to pollution.	Dr. C. Kelly, London Practit., 1886, XXXVII, pp. 223-231.
81	October, 1886	Carlisle	30		24	(1) 59	Traced to a dairy where typhoid cases had existed, preceded by a febrile disorder among the cows; water supply and sanitation being quite good.	William Brown, Sanitary Record, London, 1887-88, n. s. IX, pp. 10-15. Practit., London, 1888, XV., pp. 382-392.
82	Nov. and Dec., 1886	Cambridge, Mass.	73				The epidemic invaded 36 families, and was traced to a certain milk farm where a child was ill with typhoid fever; the father had entire charge of the nursing, emptied the excreta, and also prepared the milk for the market.	Chas. Harrington, Boston Med. and Surg. Jour., 1888, CXIX, pp. 49-52.
83	Feb., 1887	Göteborg	43		43	100	Affected 34 families, all supplied with a particular milk. Typhoid fever at milk farm, and suspicious sanitary conditions.	Dr. Ernst Almquist, Vrtljschr. f. Gesundhtspflg., 1889, XXI., pp. 327-338.
84	Aug., 1887	Do	5		5	100	In 3 families, typhoid fever at farm.	
85	1887	Denmark					Dr. Lehmann of Copenhagen, before the International Congress of Hygiene and Demographie, held at Wien, 1887, described 2 epidemics of typhoid fever traced to a certain creamery, and pointed out the difficulty of tracing infection when milk is received from a number of farms and mixed.	Deutsche Med. Wochenschrft, 1889, Vol. 15, p. 17.
86	Mar., 1888	Göteborg	4				Typhoid fever at milk farm, and bad unsanitary surroundings.	Dr. Ernst Almquist, Vrtljschr. f. Gesundhtspflg, 1889, XXI., 327-338.
87	1888	Wash. Heights, N. Y.					Dr. Edson is quoted as having reported this epidemic of a disease resembling typhoid fever, confined to the customers of a certain milkman. On careful inspection of the cows 1 of them was found to be suffering from a loathsome abscess of the udder. The cow was being milked into the common pail. No other cause could be found, and the sickness speedily stopped when this cow was quarantined.	Brooklyn Med. Jour., 1888, Vol. 1, p. 182.
88	July to Dec., 1888	Spennymoor, Durham.	25	5			Outbreak occurred in 19 families, 11 of which were supplied with milk from a dairy where typhoid fever and evidence of polluted water were found.	Dr. David Page, Public Health, June, 1889; Lancet, London, 1888, Vol. II, p. 941.

[1] Appears to be wrong. Should be 80? H. B. B.

Epidemics of Milk-Typhoid. (*Busey and Kober.*)—CONTINUED.

No.	Date.	Place.	No. of cases.	No. of deaths.	No. of cases among milk consumers.	Per cent.	Circumstances of the outbreak.	Reporter and reference.
89	1888	Evesham	6	1	5	83	Typhoid at dairy; milk adulterated with polluted water.	Dr. Fosbroke, Public Health, Feb., 1889.
90	1889	Country town in New York.	200 (1)	----	----	----	Investigation showed that only the customers of a certain milkman were affected. His well was contaminated by the drain of a neighbor's house in which typhoid had recently occurred. Water used to wash milk cans, and possibly also for adulteration.	Dr. William M. Smith, quoted by Dr. Cyrus Edson, Med. Record, N. Y., XXXV, 1889, p. 10.
91	1889	St. George, Hanover Parish.	----	----	----	----	Dr. Barry, medical inspector, reports to the local government board on this sudden and localized outbreak of enteric fever, which he attributed to temporary admixture of infected milk with the usual supply, and also refers to nuisance from sewer ventilators, etc.	Report Med. Off. local government board, 1889, p. 47.
92	Feb. to Apr., 1889	Dundee	23	----	23	100	All cases occurred among the customers of a particular dairy, and the most searching inquiries failed to find any trace of disease among the persons handling the milk or in the household, but one of the milch cows was suffering from a peculiar teat eruption, and as the disease declined upon stoppage of the milk, April 15, Dr. Anderson feels justified to regard the cow as an etiological factor. Other sanitary improvements were made in connection with sewer.	A. M. Anderson, Brit. Med. Jour., London, 1889, II, p. 465.
93	February, 1889	Stirling	40	4	40	100	Typhoid fever at milk farm; polluted water; air of the milk house liable to contamination. The epidemic affected especially families supplied with milk which had been kept overnight in the milk house.	Dr. McFadyan, Brit. Med. Jour., London, 1889, Vol. I., p. 1250.
94	March, 1889	Strand District, London.	10	----	10	100	Dr. Conway Evans, the medical officer of that district, reports that he had traced 10 cases of typhoid fever to the milk supply and was ordered to visit the farm and take necessary steps.	Brit. Med. Jour., 1889, Vol. I., p. 725.

95	June, 1889	Svarteberg, Sweden	104	11			Typhoid-fever cases at milk farm; contaminated water used for dairy purposes, also for adulteration of milk.	Ernst Almquist, Zeitschft. für Hygiene, Leipsic, 1890, Vol. VIII, 137-140.
96	July, 1889	Belgard	11		11	100	All the 11 typhoid fever cases had obtained their milk of the owner of a single milch cow, a poor woman, whose child was ill with typhoid fever, the milk being kept in a safe in the sick room, it being the only room at their disposal.	E. Roth. Deutche, Vrtljschr. f. öffentl. Gesundhtspfl., 1890, XXII, pp. 238-245.
97	July, 1889	Leeds	[2]20	(3)			No details as to the condition of the dairy farms given. Cases occurred in the best residential part and were traced to a particular milk supply.	Dr. Goldie, M. O. H., Brit. Med. Jour., 1889, Vol. II, p. 110.
98	November, 1889	York	120				Three cases of typhoid fever had occurred at the milk farm. Inspection revealed a probably infected well close to the privy; milk vessels kept close to privy and milk adulterated with 10 % of polluted water.	S. W. North. M. O. H., The Practioner, London, 1889, XLIII., 393-400.
99	Jan.-May, 1890	Geneve	63				The epidemic was traced to a particular dairy where the most unsanitary conditions were found. Men were seen spitting in their hands while polishing milk cans. There was also evidence of reckless watering of the milk with polluted water.	Dr. Vincet, Epidémie typh. propagée par le lait, Geneve, 1890, p. 15.
100	May, 1890	Forfar	36				Three cases of typhoid fever at the dairy farm whence milk was supplied to 28 families. Milk exposed to the contamination of an infected drain.	Dr. Murray, M. O. H., Sanitary Jour., Glasgow. 1890-91; n. s., XIV., p. 113.
101	May, 1890	Nottingham	7		7	100	Nephew of milkman sick with walking typhoid fever; continued at work. Milk supply stopped June 20. After June 26 no fresh cases occurred.	Dr. Phillip Boobyer, M. O. H., Annual Report, 1890, Public Health, London, 1891, 92, IV., p. 110.
102	June, 1890	Waterbury, Conn.	50		41	82	Typhoid fever cases at the milk farm from which at least 41 of the cases had consumed milk. One of the farm hands continued to work in the care of cans and at milking for a week before giving up; he also defecated in the cow stables throwing the stools into the barn yard and thus infecting material everywhere.	Dr. Herbert E. Smith, Sanitarian, N. Y., 1890, XXV., pp. 298-309.
103	July, 1890	Stittenseen, Hanover	103				This epidemic affected only persons who had drunk water from a specifically infected well or skimmed milk from a certain creamery supplied by 70 or 80 milk producers, and the evidence appears to indicate that this milk supply was contaminated by the owner of the suspected well adulterating the milk; 8 cases occurred in the house with the suspected well and 78 cases among contributors of milk to the creamery, and who, of course, were the largest consumers of their skimmed milk.	Dr. Schröder, Zeitschft. f. Med. Beamte, Berlin, 1891, IV, pp. 227-262.

[1] Nearly. [2] Or more. [3] Several deaths.

Epidemics of Milk-Typhoid. (*Busey and Kober.*)—CONTINUED.

No.	Date.	Place.	No. of cases.	No. of deaths.	No. of cases among milk consumers.	Per cent.	Circumstances of the outbreak.	Reporter and reference.
104	July, 1890	Wyandotte, Mich.	11	2	11	100	All supplied with milk from a stall-fed cow which drank water from a well polluted with animal matter. Cases continued to occur as long as this milk was used, and disappeared upon its stoppage, except in 1 family, who returned to the milk, and this was followed by 2 more virulent cases in the family. Professor Vaughan examined the milk and water bacteriologically, and while failing to discover Eberth's germ, he found similar pathogenic germs in both media, in larger proportion in the cow's milk.	Dr. E. P. Christian, Am. Lancet, Detroit, 1891, n. s., XV, pp. 121-128. Phys. and Surg., Detroit, 1892, XIV, pp. 337-343.
105	August, 1890	Lauchstädt	74	9	----	----	The first and greatest number of cases occurred at a watering resort, which was supplied both with water and milk from a farm where typhoid cases had occurred.	Dr. Penkert, Zeitschft. für Med. Beamte, Berlin, 1891, IV, p. 50.
106	August, 1890	Waversley, Randwick, Sidney.	89	----	----	----	These cases occurred in 89 households, and "the outbreak was clearly proved to be caused by contaminated milk." [We have been unable to refer to Dr. Thompson's original report.]	London Lancet, 1891, Vol. I, p. 223.
107	August, 1890	Toorak, Australia	----	----	----	----	A number of cases occurred, all pointing to a particular milk supply derived from a farm which was watered by a creek to which the cows had free access; an orchard on which infected night soil had been deposited drained into the creek higher up. No evidence given whether the milk had been adulterated with this polluted water, where the cans were washed, or whether udders were infected while cattle waded in the stream.	Austrl. Med. Jour., 1890, n. s., XII, p. 422.
108	Sept. and Oct., 1890	Edinburgh	63	3	----	----	The outbreak occurred in 41 families who derived their milk from a farm where a case of typhoid was found, and 2 others subsequently occurred there Sanitary conditions bad; milk cans filled in a tainted atmosphere; water-supply found to be contaminated by sewage and liable to gross pollution. Milk supply was stopped until a better water-supply had been provided, after which no more cases occurred.	Dr. Harvey Littlejohn, Edinburgh, Med. Jour., 1880-91, XXXVI, Part II, pp. 801-814. Brit. Med. Jour., 1890, Vol. II, p. 1,318.

109	1891	U. S.	2	----	------	----	Dr. Brady describes 2 cases of typhoid fever which he attributed to infected milk, and considers it perfectly conceivable when we recall the sanitary condition of the average milk farm, and the dairy boy with bespattered boots, dirty hands and shirt, etc.	Dr. E. J. Brady, Cincinnati Lancet and Clinic, 1892, n. s., 28, p. 20.
110	1891	Decatur, Ill.	5	----	5	100	Typhoid fever at dairy conveyed by digital infection, as dairy hands also assisted in nursing the typhoid patients.	Dr. E. J. Brown, Trans. Ill. Med. Society, Chicago, 1891, XLI, pp. 145 148.
111	Feb., 1891	Avondale	12	----	12	100	Two cases of typhoid fever at a dairy. Milkers and dairy hands also assisted in nursing. Water probably contaminated and owner in the habit of diluting the milk.	Dr. E. W. Mitchell, Cincinnati Lancet and Clinic, 1892, n. s., 28, p. 647.
112	June, 1891	Grosse Isle, Mich.	8	1	8	100	All these cases received the milk from one cow which had no access to pure water, but drank from a nearly dried up swamp on the island. (No bacteriological examination of the water.)	Dr. E. P. Christian, Phys. and Surg., Detroit and Ann Arbor, 1892, XIV, 337-343.
113	August, 1891	Shawland, Glasgow	42	4	37	89	Mild case of typhoid at the farm in August. Dung-pit located near byre received the typhoid excreta; the water supply contaminated from this dung-pit; other unsanitary surroundings.	Dr. A. M. Campbell, Public Health, 1891-92, Vol. IV, p. 275.
114	October, 1891	Borough of Nanticoke, Pa.	42	----	31	74	A case of typhoid fever at the dairy farm, attributed to a contaminated well which received drainage from a cemetery.	Dr. L. H. Taylor, Annales, Hygiene, Philadelphia, 1892, Vol. VII, pp. 393-403.
115	Spring, 1892	Plymouth, Eng.	12	1	12	100	A fatal case of typhoid occurred at the milk farm twenty days before the present outbreak. The parents continued their dairy work while nursing their sick child.	Dr. F. M. Williams, M. O. H., Brit. Med. Jour., 1892, Vol. I, p. 1,157.
116	August, 1892	Springfield, Mass.	150	25	101	67	After a painstaking investigation, traced to a particular milk farm, where cases of typhoid had occurred ever since last spring. Well liable to infection from dejecta of patients. Milk contaminated by placing cans in the well for the avowed purpose of keeping the milk cool.	Drs. Sedgwick and Chapin, Boston Med. and Surg. Jour., CXXIX, 20, p. 485, 1893.
117	Aug. 20-Sept. 10, 1892	Somerville, Mass.	35	----	30	86	Epidemic traced to a particular milk supply. The son of this milkman handled and delivered the milk while suffering from a mild attack of typhoid fever, which had remained unrecognized until the investigation disclosed exact facts.	Dr. W. T. Chapin, Boston Med. and Surg. Jour., CXXIX, 20, 1893, p. 485.
118	Sept. 14-Oct. 15, '92	Greenwich, Rotherhithe.	61	----	56	91	This epidemic was limited to consumers of ice cream manufactured by Italian vender. Investigation revealed the existence of several cases of enteric fever in two ice cream shops, and much reason for believing that ice cream was prepared in dangerous proximity to the patients.	Dr. Geo. Turner, Practit., London, 1892, XLIX., p. 141, 160.

Epidemics of Milk—Typhoid. (*Busey and Kober.*)—CONTINUED.

No.	Date.	Place.	No. of cases.	No. of deaths.	No. of cases among milk consumers.	Per cent.	Circumstances of the outbreak.	Reporter and reference.
119	1893	Altenmuhr	(1)				A house epidemic existed at a certain farm. A young gentleman took sick with enteric fever, while visiting a neighboring chateau. He had been supplied with milk from this farm, and his female servants who carried the milk were taken sick likewise.	Dr. Franz Spaet, Arch. für Hygiene, München and Leipzig, 1893, XVII., p. 306.
120	1893	Bandon	(1)				In this instance Dr. Wepley traced the infection to a creamery which collected milk from a number of farms, at one of which a few cases of enteric fever occurred, infection originally carried from Cork. The milk at these creameries is separated, the cream made into butter, and the skimmed milk returned to farmer, thus causing intimate relationship, and the disease may easily become widespread among the users of milk.	Dr. Wepley, Brit. Med. Jour., 1893, Vol. II., p. 698; London Lancet, 1894, Vol. II., p. 1085.
121	Feb., 1893	Univ. of Virginia	14		14	100	These cases of a typical typhoid fever occurred among the students of the university, all boarding at the same hotel and consuming a particular milk supply from a dairy which is located on the banks of the creek, which receives the sewage from one of the main university sewers. An ignorant negro, who lives 1 mile above the dairy, had typhoid fever during the preceding fall, and his dejecta was thrown on the ground without disinfection. The milkman used creek water to wash the udders of the cows.	Dr. Wm. C. Dabney, Med. News, Philadelphia, 1893, LXIII, 630-632.
122	May, 1893	Oakland, Cal.	362		228	70	These cases occurred within one month, and as 70 per cent were consumers of milk from one particular dairy, a sanitary inspection was made and revealed the following facts. A typhoid fever house in close proximity; dejecta thrown on the ground close to a small dam in the creek, from which a pipe supplied a large tank 75 feet below with water for dairy purposes; moreover this polluted water flowed through the cow pasture.	Dr. S. M. Mouser, Occident Med. Times, Sacramento, 1893, VII., pp. 503-504.

123	July, 1893	Paisley, Renfrewshire	86	....	86	100	This epidemic was traced to the consumption of ice-cream made at the premises of a vender where an unreported case of typhoid fever was found, and this patient had remained in contact with the business during most of her illness.	Dr. Campbell Munro, Brit. Med. Jour., 1894, Vol. II., p. 829.
124	Aug., 1893	Rostock	(1)	....	.....	....	All traced to milk from a suburban dairy found in the most unsanitary condition; no privy, but a highly polluted well, which was used for washing the utensils and very likely also for adulteration.	Dr. Lesenberg, city physician, quoted by Dr. Dornblüth, Jahrbuch f. Kinder Krankheiten, 1893, XXXVI., p. 181.
125	July, 1893	Vicinity of Bethsada, Montgomery Co., Md.	15	1	15	100	This limited epidemic was intimately connected with a certain milk farm, the owner of which was obliged to use a neighbor's well, in whose family typhoid fever had occurred during the summer of 1892. Three weeks after using this well the first case occurred at the milk farm, and shortly after the owner of this well was also taken sick. This resulted in a cleaning of the well, which was found to be contaminated with a very foul sediment, a dead chicken, and other organic refuse. The season being unusually dry, and the ground water being low, had resulted in concentration of the impurities, and as this well had been used for dairy purposes, it was doubtless the source of infection.	Unpublished memoranda furnished by our friend, Dr. George Lloyd Magruder of Washington, D. C., and Dr. W. F. Elgin, of Montgomery Co., Ala.
126	July to Sept., 1893	Shildon, Durham Co.	....	....	.....	....	In a very extensive epidemic of enteric fever a large share in spreading the fever was due to a particular dairy, where cases of typhoid fever existed and the wife, who managed the milk business, also nursed the sick children. There was, moreover, a direct connection between the sewer and the room in which the milk and utensils were kept.	Dr. Bruce R. Low, Rep. to the local government board on an outbreak of enteric fever at Shildon, London, April 23, 1894.
127	1894	Castle Island, Ireland	....	....	.....	....	A serious outbreak was traced to a creamery receiving among others the milk from a farm where enteric fever had occurred, and which was handled by a person who also assisted in nursing those suffering from the disease. The cream had been seperated and the skim distributed in due proportions among the different farms.	Brit. Med. Jour., 1894, Vol. I., p. 815.
128	Jan. and Feb., 1894	Richmond Hill, Surrey Co.	55	....	52	94	Traced to a common milk supply; no evidence of typhoid fever at the milk farm, although the disease had prevailed in the vicinity; very unsanitary contitions, such as liquid and semi-liquid filth surrounding 36 cows. The epidemic speedily subsided after stoppage of the milk supply from this dairy.	Drs. Rowland and Seaton, Brit. Med. Jour., 1894, Vol. I, p. 1325.
129	Mar. and April, 1894	So. Lambeth	59	10	55	93	Traced to a particular milk depot, affording no other evidence except unclean methods and a water supply subject to pollution from a yard drain. The water tank, on being emptied, contained a deposit of 4 inches of offensive matter; no bacteriological examination.	Brit. Med. Jour., 1894, Vol. I, p. 1148.

[1] Several cases.

Epidemics of Milk-Typhoid. (*Busey and Kober.*)—CONTINUED.

No.	Date	Place.	No. of cases.	No. of deaths.	No. of cases among milk consumers.	Per cent.	Circumstances of the outbreak.	Reporter and reference.
130	Mar., 1894	Montclair, N. J.	107	14	----	----	Of 44 families supplied with milk from a particular dairy, typhoid fever occurred in 28, or 63.6 per cent. Of 20 cases reported from Bloomfield and Glenridge, 18 were traced to the same dairy, where a case of typhoid occurred Feb. 11, but the sale of milk was not stopped until Mar. 29, and epidemic checked promptly after that date. Unsanitary condition at dairy and polluted well water.	Dr. R. C. Newton, Med. Record, N. Y., 1894, XLV., pp. 713-715.
131	May, 1894	Brixton	60	10	----	----	This epidemic was traced to a milk farm where the cows were partially fed on fresh grass cut from the fields of a sewage farm. It was also shown that water from a brook running through the same land, and presumably contaminated, had been used to adulterate milk.	Dr. Verdon, M. O. H., Brit. Med. Jour., 1894, Vol. I, p. 1112.
132	Aug., 1894	Montclair, N. J.	19	1	----	----	Fourteen of these cases were found in close proximity to a bakery where ice cream was sold and made in a very filthy place. A case of typhoid had occurred at this bakery, and persons who made the ice cream also assisted in nursing. Of 10 cases, 8 had used ice cream or milk from this bakery, and the disease was promptly checked upon closing the bakery.	Dr. Thomas Horton, Med. Rec., N. Y., 1894, XLVI, p. 651.
133	July, 1894	Bayhead, N. J.	15	----	15	100	This limited outbreak was confined to customers of a milk dealer who derived his supply from three dairies, at one of which a young man was taken sick July 1, with what proved to be a case of typhoid fever, and continued to milk his cows daily until July 11. The first case of typhoid fever among consumers of the milk occurred July 14, and the last case 19 days after this patient stopped milking. How the infection could be conveyed may "be left to the imagination of those who are familiar with the personal habits of some who work on dairy farms."	Dr. W. H. Katzenbach, N. Y. Med. Record, 1895, Vol. 47, p. 165.

134	Dec., 1894	Arbroath, Scotland	44	----	------	----	This epidemic was traced to an unrecognized case at a dairy. The patient there was a woman 64 years old who had been waited on by two other women, who also milked the cows, washed the milk vessels, and attended generally to the sale of milk. Many of the later cases of the outbreak were not directly attributable to the milk sale, secondary centers of infection having, as is quite common, been established.	London Lancet, Vol. II, 1894, p. 1517.
135	Jan., 1895	Great Harewood	80	5	------	100	Consumers of raw milk were attacked more virulently and with greater certainty than those persons who took the milk in coffee and tea. The chief symptoms were headache, often diarrhea, sometimes nausea, characteristic temperature, and frequently abdominal rose spots. Traced to a milk farm, where a young woman who assisted in milking the cows and looking after the cans had been sick since and prior to the outbreak with what she thought to be a cold. Upon examination she was found with a coated tongue, a pulse 108, temperature 100, and a few days after rose colored spots appeared on her body, in fact, a typical case of ambulatory typhoid fever. The decline of the outbreak, allowance being made for the period of incubation, coincided with her withdrawal from the dairy operations.	Dr. Edw. Sargeant, London Lancet, Vol 1, 1895, p. 1328; Brit. Med Jour., Vol. 1, 1895, p. 1110.
136	Apr. and May, 1895	Stamford, Conn.	307	----	------	----	Traced to the premises of a milkman whose barns were in the rear of his lot, surrounded on all sides by dwellings and outhouses; his tank for cooling milk was fed from a well 12½ feet deep and filled with water to within 1½ ft. of the surface. West of the pumps were two outhouses, one 20 feet and the other 15 feet each above the level of the bottom of the well, and the drainage of those led directly toward the pump. It is believed the typhoid germs were brought to this neighborhood by Italians who had been at work in the vicinity of the dairy and the disease was traced almost directly to their camp. The well water was examined by Dr. T. M. Prudden, and found to be swarming with bacteria.	Med. Record, N. Y., Vol. 47, pp. 562, 627.
137	Apr. and May, 1895	New Milford, Conn.	23	----	------	----	The daily papers contained accounts of an epidemic of typhoid fever which is prevailing in New Milford. The disease is said to have been distributed by milk obtained from a certain farm in the neighborhood. Up to May 9, 23 cases had been reported. (Details wanting.)	Med. Record, N. Y., Vol. 47, p. 627.
138	June 22, 1895	Woolwich	19	----	-- ---	----	In 10 of these cases the milk was supplied from the same dairy and others from various sources. In 4 cases the milk supplied was from the Plumstead dairy, where the epidemic first broke out. This dairy has been closed by the authorities.	Brit. Med. Jour., Vol. 1, 1895, p. 1423.

Epidemics of Milk-Typhoid. (*Baker.*)—CONTINUED.

(Outbreak No. 139 and the eight succeeding ones were collected by Henry B. Baker, M. D.)

No.	Date.	Place.	No. of cases.	No. of deaths.	No. of cases among milk consumers.	Per cent.	Circumstances of the outbreak.	Reporter and reference.
139	Nov., 1895	Providence, R I.	31	3	31	100	A milkman kept no cows, but obtained his milk from two farmers in the same town. On one farm no trace of disease could be found; on the other it was learned that there had been two cases of typhoid. The nurse taking care of the milk as well as the sick. When this fact was learned the milk from this farm was not sold and the epidemic stopped.	Report of Supt. Health Dept., Chas V. Chapin, M. D., Providence, R. I., in report of Dec., '95.
140	May, 1894	Montlignon, near Paris.	----	----	----	----	First case, origin unknown, recovered. The clothes of the person having been sick, were washed in a brook which flowed past a milkman's place. This milkman had been in the habit of washing his pails in this brook. Dr. Hourlier is convinced that the milkman carried disease to his customers in the milk served them. Dr. Hourlier traced another case to another dairyman, who, being out of milk, borrowed from the first and became sick.	Dr. Hourlier, in the Progrès Médical.
141	Sept., 1894	Marlborough, Mass.	49	----	49	100	Apparently due to infected skimmed milk. A man was engaged in peddling milk from a creamery, located in the midst of the infected district. He was taken sick with typhoid about the time the epidemic was raging its highest, but facts in his illness went to show that he might have been the unconscious cause of the whole epidemic. He continued at his work for 10 or 12 days before taking to his bed, during which time he had typhoid symptoms.	Report of W. T. Sedgwick, in Mass. Am. Report, year 1894, p. 765.
142	Winter of 1872-73	Near Birmingham, Eng.	50 (1)	----	47	94	Defective sanitary conditions on the dairy farm. Dejecta contaminating the water in the well. The dairyman used the water in the well to dilute his milk.	Ernest Hart, D. C. L., Brit. Med. Jour., July 13, '95, p. 89.
143	1875	Renfrewshire, Eng.	153	----	153	100	"Unmistakably to a particular milk service"	Do.

144	1876	Leeds					A case of typhoid existed on a farm. The cow, whose milk was used only for domestic supply, refused to graze. She was sent away and convalescence of the patient set in. The fact developed that in her first pasture, her water supply was contaminated by the drain of a sewer.	Do.
145	May and June	Plumstead, Eng	177	23	159	90	Actual source of disease could not be definitely located, but was distinctly traceable to a particular milk supply. On the dairy farm, the drains were very defective, the cow sheds dirty, and business conducted in a slovenly manner.	Dr. Sydney Davies, Brit. Med. Jour., Dec. 21, 1895, p 1561.
146	April, 1895	Stamford, Conn	386	22	376	97	This epidemic was caused by infected milk. Origin of the infection not satisfactorily determined. The probable supposition is that the milk became infected from contaminated well water used in washing the cans. Privy 25 ft. from well and natural surface drainage toward the well. Privy had a shallow vault and was leaking at the top. Water in well 1½ ft. from land surface. Sanitary conditions of the dairy building poor. One low frame building in which were the cow stables, and also, at one end of which was the sink used for washing the cans.	Dr. Herbert E. Smith, Report on the Stamford typhoid fever epidemic, Connecticut. Library No. 9603.
147	June, 1890	Waterbury	50		44	88	Three cases of typhoid appeared on the dairy farm. One case of ambulant typhoid fever—one week. Dairy work not done with sufficient caution Milk set to cool in a tank near to the manure heap Tops of cans opened slightly and subject to infection from particles floating in the air. Deficient sanitary conditions about the farm, and particularly in the dairy room.	Dr. Herbert Smith, Report State Board of Health, Conn., 1890, p. 243, also Pamp. Library No. 7516.

[1] Households.

Epidemics of Milk-Typhoid. (*R. G. Freeman, M. D.*)—CONCLUDED.

(Outbreak No. 148 and the ten succeeding ones were collected by R. G. Freeman, M. D.)

No.	Date.	Place.	No. of cases.	No. of deaths.	No. of cases among milk consumers.	Per cent.	Circumstances of the outbreak.	Reporter and reference.
148	Aug., 1881	Hawick	---	---	---	---	Nearly every case received milk from a farm where typhoid prevailed. Milk supply stopped.	Br. Md. Jr., '81, ii., 273.
149	1881	Christ Church, New Zealand.	---	---	---	---	All houses infected (including a lunatic asylum) were supplied by same dairy. Dairy premises in a filthy condition.	Br. Md. Jr , '81, ii , 570.
150	1882	Glasgow	---	---	---	---	Cases were consumers of milk from a dairy where typhoid had recently existed.	Br. Md. Jr., '82, ii , 590.
151	Nov., 1882	Grangemont	---	---	---	---	Cases supplied with milk from a house where there was a case of typhoid. Milk was ordered destroyed until the typhoid patient was removed.	Br. Md. Jr., '82, ii., 911.
152	Jan.-July, 1883	Cologne	280	---	61	---	Several cases of typhoid at a dairy. One case nursed near cow stables.	Auerbach, Schmidt's Jahrb , '83, ccvii , 72.
153	1883	Warwickshire	12	1	12	100	Milk dealer died from typhoid and his son contracted it from him. Milkman's water supply polluted.	Br. Med. Jr., '83, i., 1, 136.
154	1883	Upsala	37	---	---	---	Followed typhoid in milkman's family	Almquist, Ztschr, für Hyg., Vol. 890, p. 137.
155	Oct. to Dec., 1884	Port Jervis	148	---	128	---	Typhoid at dairy in August and September, three cases. These were nursed by the same person who attended to the dairy work.	Curtis, Rep. N. Y. Bd. of Health, '84, 185.
156		Minnèguc	---	---	---	---	All the cases had milk from one dairy. In one family all who drank the milk raw, contracted typhoid, while, those who drank it cooked escaped. Water supply near privy. Case of typhoid previously in farmer's family. Epidemic stopped with the withdrawal of milk.	Janssen, Rouvier, Le Lait, p 208.
157	July-Aug , 1888	Providence	96	---	86	96	Three cases of typhoid at dairy. One a few weeks preceding epidemic.	Swartz. (Reference not published.)
158	1888	Durham	12	---	12	100	---	O'Hanlon, London Lancet, '88, ii., 941.

159	Nov., 1888	Cambridge, Mass.	73	----	58	----	Traced to one milk route. Typhoid fever found at one of the farms supplying this milk route.	Harrington, Rep. Mass. Bd. of Health, '88, p. 25.
160	Mar , 1889	Melbourne	43	----	43	----	Originated in a case in the family of the milk dealer	Allen, Intercol. Med Congress, Melbourne, '89.
161	1890	Geneva, Switzerland	--	----	------	----	Traced to the milk of one dairy. It was shown that the dairyman washed his pails in a stream in which the linen of a typhoid patient was washed, Milkman sued dairyman for damages and got 1500 francs.	Vincent, Lancet, '90, ii., 730; Br. Med. Jr., '92, 1., 1279.
162	1891	Whitechurch	--	----	------	----	Cases occurred among drinkers of milk from a dairy where a child sick from typhoid was allowed to handle dairy utensils. Milk dealer fined.	Br. Md. Jr., '91, ii , 1179.
163	Feb. to Apr., 1891	Sutton, Coldfield	40	5	40	100	All cases had contaminated milk. Epidemic stopped by stopping milk supply.	Hill, Br. Md. Jr., '91, p 136.
164	Aug. and Sept., 1892	Dundee	82	6	43	----	Typhoid at dairy in August. Milk supply stopped August 28th.	Anderson, Br. Md. Jr , '92, ii., 902.
165	June, 1892	Nottingham	7	----	7	----	Dairy assistant worked for three weeks while suffering from fever, vomiting and diarrhœa. Dairy supplied twenty-six families.	Boobyer, Public Health, '92, iv., 110.
166	Dec., 1891, to Jan , 1892	Clermont, Ferrand	23	6	18	.. .	Originated in dairy where the proprietor and his daughter had typhoid.	Gayon, etc., Rev. de H., '92, 993.
167	1892	Near Leeds	----	----	------	----	Every case except one supplied by milk which had been mixed with contaminated water.	Ballard-Arnley, Stevenson and Murphy, Hygiene, i , 334.
168	Aug., 1893	----------	23	----	23	----	Creamery case. Typhoid on one of the farms contributing to the creamery. Nineteen cases infected from the creamery milk.	Welpey, Lancet, '94, i , 992.
169	1893	E., near Strasburg	----	----	------	----	All the cases had milk from one milkman. Seventeen per cent of those who drank the milk had typhoid, while among three hundred others there was no case. Epidemic stopped on withdrawal of milk.	Schmidt, Hyg. Rundsch., 94, p 694.
170	Oct., 1895	Shettleston	35	2	15	----	Case of typhoid at dairy in September. Dairy supplied sixteen families and seven of these, or over forty per cent, suffered.	Wilson, Br. Md. Jr., '95, ii , 1204.
171	----------	----------	----	----	------	----	A farmer nursed his son sick with typhoid; twenty-one days later typhoid became epidemic in two institutions supplied by him with milk, as well as in most of the families he supplied.	Tripe. Rouvier de Lait, p. 209.